

FEB 10 1937

DISCOVERY

A Monthly Popular Journal of Knowledge

February 1937

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The Great Iceland Geyser

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(Continued on page xv)



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DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XVIII. No. 206 FEBRUARY, 1937.

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Editor: L. RUSSELL MUIRHEAD, M.A.

Publishers: BENN BROTHERS, LTD. A. communications respecting editorial matters to be addressed to the Editor; all questions of advertisements and subscriptions to the Manager. Offices: Bouverie House, Fleet Street, London, E.C.4. (Closed on Saturday.)

Telephone Central 3212. Telegrams: Bembrolish, Fleet, Lon. Annual Subscriptions 12s. 6d. post free anywhere in the world. Single numbers 1s. net; single back numbers more than two years old, 12s. 6d. net; postage (inland and foreign) 2d. Binding cases, price 2s. 6d. net each; postage 6d.

Notes of the Month.

LAST month was published the interesting and suggestive *Report of the British Commonwealth Scientific Conference* (H.M. Stationery Office. 1s. 3d.) The Conference was an outcome, perhaps the most fruitful one, of the Imperial Economic Conference of 1932; and its members were the Imperial Agricultural Bureaux created in 1927. Obviously one of the principal aims of such a conference is the investigation of the possibilities of liaison between the countries and institutions concerned; and the appointment of liaison officers to foster co-operation was recommended. At the same time research workers should be given every opportunity of visiting institutes in other countries with a view to the fuller exchange of work-programmes, though the difficulty of exchanging individual workers between institutes was fully appreciated. The extension of expenses suggested was less lavish than we have come to expect from the deliberation of such conferences; the cost of the proposed new Bureau of Dairy Science was to be met in part by the cessation of certain grants; and the very modest appropriation set down for a new Bureau of Forestry should surely be justified by the imperial importance of the subject.

* * * *

Wise emphasis was laid on the special need for further research on the transport and storage of foodstuffs. An information service on the subject was needed to supplement the Index to the Literature on Food Investigation published by the Department of Scientific and

Industrial Research. Fuller research and interchange of information on the subject of the control of damage by termites was advised. The economic importance of this problem is far from being generally realised, especially in those parts of the British Commonwealth where the climate is unsuited to the termite, and despite the excellent work that is being done in many places, the information collected has not been fully correlated. Mr. Walter Elliot, who opened the conference, reminded the members of the paradox that always confronts scientists: the greater the progress made in research, the greater the need for further effort. Is it too much so hope that the field of organised interchange of scientific effort may one day be wider even than the British Commonwealth?

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The latest *Bulletin of the Imperial Institute* contains some interesting material, contributed by G. H. Tipper, on vanadium-bearing magnetic deposits in Bihar, India. Analysis of a number of samples of the ore indicates that the material varies considerably from place to place, the vanadium content expressed as the oxide ranging from about one-half per cent. to over seven per cent., while the amount of titanium oxide varies from about 10 to 28 per cent. Similar ores are understood to be used in Russia for the preparation of ferro-vanadium, but, although the Indian deposits are certainly richer in vanadium than those known elsewhere, much careful work still remains to be done before their future can be determined. Another informative article in this issue reviews efforts which have been made and the success achieved in the production of metallic magnesium, not only in Great Britain, but also in Germany and other continental countries, in the United States, and in Japan.

* * * *

The recent work of Winbolt, Curwen, and others on the archaeology of Sussex has attracted considerable attention to the possibilities of excavation thereabouts; and the interest of those engaged on public utility schemes entailing spade-work, always keen for a "find," is especially on the alert in that favoured county. A

short while ago, we hear from a correspondent, further Roman remains were unearthed, not far from the famous Stane Street, in the region of Pulborough, by some workmen engaged in laying a water-main. These were found to consist of the foundations of a Roman house, including probably a hypocaust and heating-chamber, if the quantity of flue-tiles discovered can be taken as an indication. The emplacement of the house confirms the belief that a Roman road ran south-east from Stane Street near Pulborough towards the slopes of the South Downs, possibly to the site of an important Roman villa.

* * * *

Professor J. H. Baxter's reports in *The Times* on the year's excavation at Byzantium of the Walker Trust (St. Andrew's) Expedition make fascinating reading. Towards the approach of winter the work became more and more arduous: not only did an enormous quantity of earth require removal, but also provision had to be made for shoring up the earthen walls against the rigours of the coming season. The most obviously exciting discovery was a long strip of mosaic of the time of Justinian which at length was found to turn at right angles, suggesting that it was part of the floor of a rectangular space. Slabs of marble in plaster, the flooring of a later Roman building which was destroyed by fire, had protected the mosaic to a certain extent, though it had suffered damage from the fall of heavy objects from above. Burials discovered at varying depths were dated by coins found in association with them; but the site was too disturbed for the pottery to be datable by stratigraphical evidence. Hellenistic

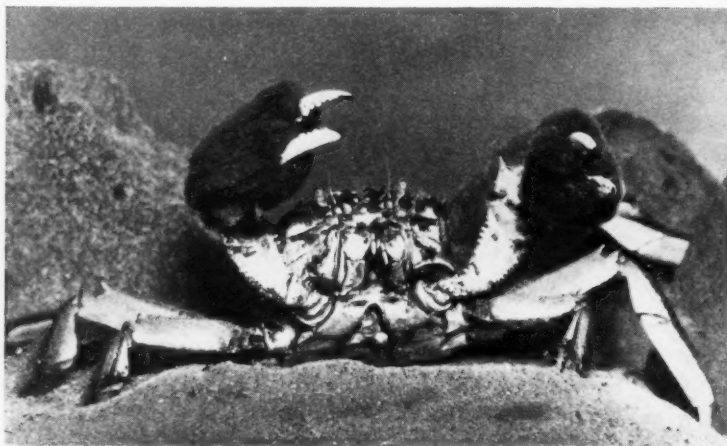
ware, for example, was found *above* the remains of a 16th century Turkish house.

* * * *

A tentative identification of the mosaic passage described above suggests that it was the terrace joining the Golden Hall of Justinian to the Church of St. Mary of the Pharos—a church which was practically the imperial private chapel—and would therefore have been the scene of many ceremonial processions. If this is so it is possible that another season's work may lead to something approaching a definite reconstruction of the Palace plan, a welcome supplement to previous reconstructions evolved by scholars from library shelves. Professor Baxter's final paragraph strikes a pleasant note in recording the uniformly cordial relations existing between the excavators and the Turkish people. Not only were the workers welcomed and encouraged by the authorities, but their work was visited by parties of schoolchildren, to whom it was explained by their teachers with both enthusiasm and knowledge.

* * * *

The warning of the danger to British rivers, especially in south-east England, which is threatened by the Mitten Crab (*Eriocheir Sinensis*) has again been sounded by Dr. Burgess Barnett in a recent issue of *The Field*. It is reassuring, however, to learn that so far the only specimen discovered in English waters was that dredged up last year off Battersea Power Station. It seems probable that the first Mitten Crab were brought from China to Europe in water-ballast tanks; and as this crab has spread since the first European occurrence was reported in a tributary of the Weser in 1912, to the Rhine, the Elbe, and the rivers of Holland and East Prussia, and as the adult appears equally at home in salt and fresh water, we cannot rely on the narrow waters of the North Sea to stem a possible invasion. The principal objection to the crab appears to be their habit of undermining muddy river-banks by burrowing, and fishermen claim that they damage their nets; the lung-fluke disease, or paragonimiasis, of which they are a carrier in China, does not really threaten Europe as yet, for the parasite which causes it depends also on another temporary host, a Chinese type of water-snail.



[By courtesy of the Editor of "The Field,"

Front view of the Mitten Crab (*Eriocheir Sinensis*), showing the furry 'mills' on the claws.

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Physical Research in the Arctic

By R. Moss and A. R. Glen

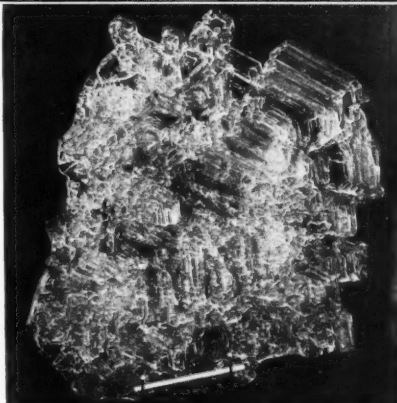
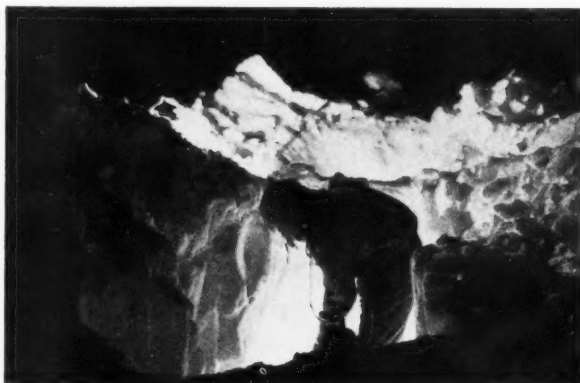
Oxford University Arctic Expedition, 1935-6.

II.—The Ice Cap Stations

The work of the Oxford University Expedition to North-East Land in connection with ozone, the ionosphere, and magnetic research was described in last month's issue of DISCOVERY. In this second article two members of the expedition describe the examination of the substance of and conditions on the ice cap.

THE greater part of the interior of North-East Land is covered by a vast sheet of permanent ice, and to investigate its properties two stations were maintained by the Oxford University Expedition of last year, one near the north coast during the winter, and the other in the centre of the eastern ice-cap for ten months. It was found possible to equip the station so that the observers had a fair degree of comfort while carrying out this work. The method adopted was a compromise between that of using a tent only, as was done by the Watkins Expedition to Greenland in 1931, and the intention of the German Expedition (whose station was about 250 miles from the British one). They had hoped to use a very light sectional building, specially designed to withstand the rigours of an ice-cap climate; but difficulties in transport prevented this, and the only living accommodation that could be constructed was a cave hewn out of the ice itself.

The Oxford University Arctic Expedition, 1935-36, used a tent very similar to that of Watkins. It was made with eight curved ribs, in the form of a large umbrella, with double walls of canvas enclosing an air space, which acted as a perfect heat insulator. The floor, on the other hand, was made of wood, also double, which served both as a clean and warm foundation, and provided the firm support which was essential for the mirror galvanometer and the electrical apparatus.



(Above) Digging a pit to examine snow conditions on the ice cap. This picture was taken at mid-day in December at 80° N., when the sun was continuously below the horizon for four months. (Below) An ice crystal discovered in the crevasse. The match shows the size.

The whole was buried beneath the ice so that it was completely protected from the wind which, as is well known, has a much more chilling effect than low temperatures alone. To do this it was only necessary to dig a circular pit four feet deep, and the enormous precipitation and drifting of snow very quickly covered up the remainder.

In fact, the top of the 8-ft. high tent was covered at the beginning of November, and by the following June it was very nearly its own depth below the surface level. It was, of course, impossible to use the canvas door in the side of the tent, and another exit had to be provided by excavating a tunnel beneath the floor, leading to a vertical shaft that was closed at its upper end by a wooden trap-door opening upwards.

During the digging of this tunnel, a good deal of information was gathered about the structure of the ice, or firn, as it is more properly called. The firn consists of granular particles of ice about the size of grain of corn, formed

by recrystallisation of the snow. Most of these are fairly firmly attached to one another, with air spaces in between, but there is usually one layer where this is not the case, and, therefore, it is liable to collapse from time to time. It is probable that this sudden settling is responsible for the "firn stoss" or "ice-quake," which is experienced occasionally, causing the whole tent to shake, and making a noise which was aptly described by Courtauld, when he heard it at the Greenland

ice-cap station, as being like that of an express train.

Besides the firn there are "blue bands" or layers of a very much harder ice, containing small bubbles of air, whereas the firn is characterised by being made up of distinct particles of ice with a more or less continuous body of air in the interstices. Apart from their scientific interest in acting as a record of the varying conditions of precipitation during past years, these bands were of great practical use, because they provide a very strong floor and ceiling to the tunnels, the height of which was so chosen that they fitted between a pair of suitable blue bands.

Branching out of the main tunnel were three chambers in the ice, one used as a storehouse for 150 gallons of paraffin, one as a larder and one as a laboratory, because, of course, it was not possible to carry out experiments on ice in the tent itself, where the temperature was permanently above freezing point. These caverns were made large enough to live in, so that, had the tent been destroyed, the work of the station could still have been carried on. Fortunately, the necessity for this never arose, but they did prove to be extremely useful during the evacuation of the station, when three men



The entrance tunnel to the central ice-cap station, cut out of the ice 20 ft. below the surface.

were weather-bound without a tent. They spent four days in one of these holes, which measured 6 ft. by 8 ft. and 4 ft. high, and found that it was quite possible for a Primus stove to keep the place fairly warm, without very much inconvenience from water melting from overhead. This was because the roof had been carefully shaped into a smooth dome, and thus drops of water would gently spread over and trickle down the walls, instead of falling from any protuberance.

There was also a shaft leading obliquely down into the depths of the ice cap. When it had been dug to 30 ft. below the surface, a hidden crevasse was encountered. This was most unexpected, for there was absolutely no trace of it on the surface. The floor of the first small chamber which was so discovered, consisted of only a thin layer of ice, which was soon penetrated, disclosing other much larger cavities below. These descended to a depth of 70 ft. below the surface, and at the bottom, most surprisingly, was a large lake of water which remained fluid throughout the time of observation. It is very difficult to account for the continued presence of such a body of stagnant water within the ice, and it seems to disprove theoretical predictions which have been made about the temperature conditions of the ice cap.

They are certainly very different from those which have already been investigated in Greenland, where the firn at a depth of 50 ft. is at -30°C. , but this is less surprising when one considers that the two ice caps are by no means comparable in size. By seismic methods the Wegener Expedition found that, in Greenland, the ice is over 6,000 ft. thick, while the highest parts of North-East Land do not rise above 2,500 ft. In the crevasse was a bewilderingly beautiful display of icicles, often thicker than a man's leg, hanging from the roof and rising up from the floor. They formed a perfect curtain to the view along the horizontal chambers lit with the fascinating blue-green light reflected from a lantern by the walls. There were also sheafs of lovely ice-crystals, shaped like leaves, but built up of aggregates of transparent hexagonal units of ice.

At various points in the walls of this shaft the shrinkage of the firn under the weight of the superincumbent layers was measured by means of an instrument, consisting of an arrangement of levers to give a suitable magnification. A column 4 ft. high is only compressed about $1/40$ th inch in the course of a day. Samples were then taken at intervals and their density determined, while a daily record was also made of the temperature. In this way the detailed mechanism of the ice cap can be worked out. The presence of the crevasse can leave no doubt that it is moving, albeit with almost infinite slowness.

The history of ice caps is obviously of great geological importance, for the whole of our own country was so covered at one time. The North-East Land ice, which, to some extent at least, reproduces in its surface the contours of the land beneath, represents an intermediate stage in the transition between the continental ice sheet typified in Greenland, where the form of the land is quite hidden, and the isolated glaciers of such familiar regions as Norway, which are the last vestiges of a past ice age.

Inside the tent were living arrangements for two men, collapsible chairs and camp beds, cooking utensils and a store of books, and besides the galvanometer already mentioned, a wireless transmitting and receiving station. Power for the transmitter was generated by a pedal arrangement, which gave uninterrupted service during its ten months' of hard use. The exertion required was about the same as in riding up a moderately steep hill on a bicycle, but the heating arrangements inside the tent worked so well that it was generally necessary to take off one's shirt when transmitting. The receiver was of a fairly usual type, and was used in daily communication with the Base Camp. During the dark time it gave perfect reception of English broadcast stations, remarkably free from atmospheric disturbances, but the strength of signals naturally fell off when the sun returned.

Little of the station could be seen from the outside, except for the two aerial masts, the tent ventilator, which had been improvised from empty tin cans, and the meteorological instruments. The latter were arranged in a circle and joined one to another with a stout rope, so as to form an enclosure from which it was impossible to stray when taking observations during the winter darkness. Experience at the northern ice-cap station showed that such an accident can easily occur, and in a blizzard it is quite impossible to find one's way back. Even when the sun had returned, the use of a safety rope was not to be despised, for, in the almost continual fogs that were experienced, the light was so evenly diffused that it cast no shadows, and thus made it quite impossible to see footprints in the snow, which might otherwise have led back to the trapdoor.

During these fogs remarkable growths of frost used to occur on the windward side of all solid objects; they took the form of cones, with their bases facing into the wind. After a few days with winds from different directions, the wireless aerial and its stays would become coated with an almost uniform layer of this frost, three or four inches thick, and as the total weight of the deposit was about a hundredweight, it had to be removed quite frequently, to prevent the wires from breaking. When the temperature was such that the



Moss examining the curtains of icicles which had to be cut down before the crevasse could be penetrated.

fog was composed of ice crystals not too numerous to obscure the sun altogether, various optical phenomena were observed in the form of coloured mock suns.

Attempts were also made to measure the actinic power of the sun's rays, but the occasions when this was possible were disappointingly rare, for there were very few clear days. When there was a mist not thick enough to cut off the rays the actinometer rapidly became coated with a layer of frost. A somewhat similar difficulty attended the taking of other meteorological readings: in a few hours the louvres of the screen which housed the thermometers and self-recording instruments would become choked with the hoar deposit. As a rule this could readily be moved, but if there happened to be a sudden rise of temperature after it had been formed, followed by a fall again, the whole mass would be converted into ice solidly frozen into position, and quite immovable until the next period of thaw. Even worse, perhaps, was when the screen became choked with drift. However, a complete record was obtained of all the meteorological elements, and is now in the process of being worked out.

Birds: a Study for All

British birds are a subject on which an unlimited amount of literature, discussion and observation is possible; but their study may be undertaken by anyone, with or without specialised knowledge. Four aspects of this study which the approaching spring season will bring once more into prominence, are illustrated in the articles which follow.

Bird Watching by Moonlight

By Phyllis Barclay-Smith

JUNE, 1936, was mostly a cold, wet month, and the fifth day of it no exception; all day long the wind blew hard, in the afternoon reaching almost gale force. But when the sun sank the wind quietened, and as the moon rose to its full richness there was a stillness which wrapped the whole countryside in peace. At 2.50 a.m. it was cold, but not a biting cold, and as I waited while the engine of the car was warming up I heard the cuckoo start its steady call. Then the joyous notes of a skylark poured out with striking loudness through the quiet night. Though everything was bathed in moonlight we had to use the headlights to find our way through the narrow, twisting lanes in the ten-minutes' drive to the edge of Hickling Broad, and the green eyes of prowling cats peered inquisitively at us as we sped along.

The grasshopper warblers, with their reeling song, made a veritable band of welcome when we reached the waterside, so loud and insistent were they; soon the reed warblers joined in from a clump of reeds a little further off, sedge warblers struck up from a nearby bush, and like the accompaniment of a big drum, the "boo-oomp" of the bittern boomed in at regular intervals. While I waited for Jim Vincent, the famous guardian of Hickling Broad, to get out the punt, a drumming snipe flew down over my head and up again, and again and again in a perfect abandon of joy, filling my ears with that fascinating sound which always brings back memories of marshes and the thrill of spring days.

As the punt glided through the silvered water of the open broad we could see the dark forms of coots and moorhens moving with bustling importance in and out of the reed beds, and uttering contented "kwongs" and "carrucks." One corner of the Broad was evidently the headquarters of the natterjack toads, for the whole air resounded with their loud chattering. At 3.15, as we passed a small patch of woodland, the flute-like notes of a blackbird rose in all their beautiful purity, but it was not until 3.45 that the drowsy call of the woodpigeon made the age-old request to "take two cows Taffy."

Lacy veils of cloud floated softly across the moon, for seconds at a time dimming our silver path, but in the

east the first streaks of dawn were beginning to appear. A pair of reed buntings, just awakened, darted up, and with a care-free "tschee" flew off across the water; as we nosed our way through the reeds a shoveller rose with a startled "quack-dequack." As the first rays of the sun were beginning to show, the bearded tits, lazy late-risers of the broads, started to flit in and out of the reeds. And all the time the bitterns boomed and the reed warblers continued their cheerful song; but we strained our ears for the sound of a chance marsh warbler in vain.

Suddenly, as we rounded a corner in the reeds, there was a whirr of wings and right over our heads flew nine swans, with their "oosha oosha oosha," gleaming white plumage and outstretched necks against the rising sun making a scene of breathtaking beauty. The moon continued to shine with such brightness on the other side of the broad that it was difficult to distinguish moonlight from sunlight. As the sun rose and gained in strength and we could feel its welcome warmth, the bird life became ever more active.

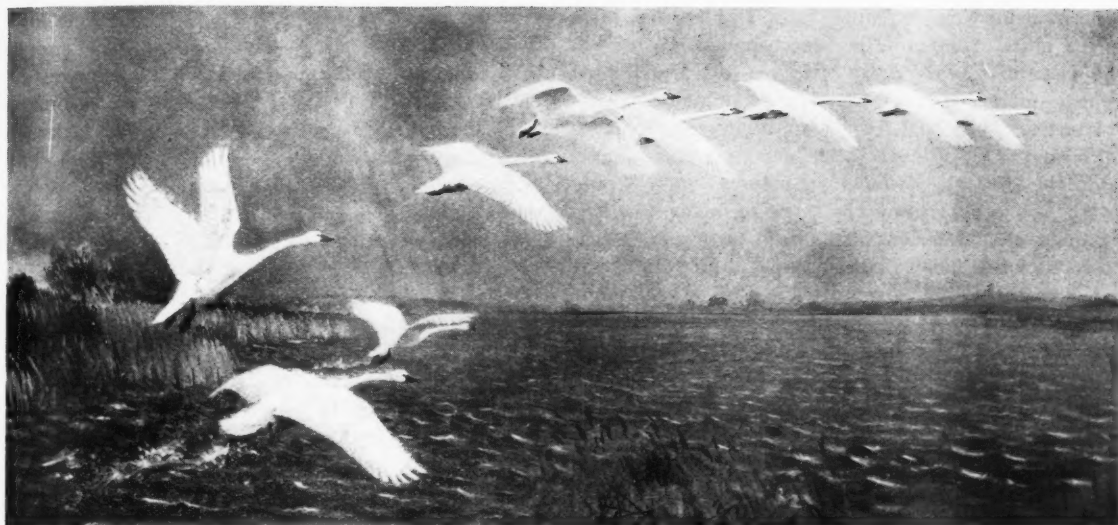
The Marsh Harrier's Nest

We brought the punt to the edge of a field and walked across it—in the distance I saw hares, crazy hares, one, two, three, a dozen of them, running and chasing each other in circles, in straight lines, in every possible evolution, seemingly senseless, but full of the joy of living, kicking their heels—catch me if you can. One, more sedate than the others, came quite close to us, sat up on his haunches and washed his face with meticulous care, not giving a hang for human intruders. We walked up on a dyke, and in the little waterway beside it a mallard became frantic with fuss, quacking loudly, feigning a broken wing, swimming round in front of us, desperately trying to draw us away from her treasured nest. On our left from the reed bed a female marsh harrier rose with the grand sweep of her wings and disappeared into the distance. We waded through the water to her nest, and there were four youngsters at the attractive age when they are clad in white woolly coats. Three were wide awake and eyed us with annoyance, but the baby was sound asleep. Jim Vincent stirred him gently, but he refused to wake up, his head being buried firmly under his brother's back. Eventually a very cross little bird was persuaded to show his face, and immediately told us what he thought of us in no

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"A whirr of wings and right over our heads flew nine swans . . ." From a painting by Roland Green.

uncertain language. It made me feel quite guilty. We went back to the field, sat on a gate, and watched for the parents, being deliciously warmed by the increasing strength of the sun as it rose in the sky. At exactly seven o'clock the two parent harriers appeared, the male "passed" to the female, who immediately took the breakfast down to the nest.

As we walked back to the punt some young heifers in the field decided we were of interest, and followed us closely, prancing and skipping with *joie de vivre*; we asked them not to, both politely and rudely, but it had no effect and they were becoming all too familiar, about 30 of them, when we reached the further gate. We settled in a sheltered clearing in the reeds and watched for bearded tits; soon we saw one, a handsome cock, with food in his mouth. Jim Vincent followed him and found the nest, hidden deeply in the reed bed. The baby "bearded" looked very comfortable tucked in carefully without a millimetre to spare. We tied up the punt and watched the birds for a long time; beautiful dragonflies, blue, red, and green, flew past us in the sunshine, and suddenly from time to time, there would be a scurry of wind, called in Norfolk a "Roger," which would tear through the clearing, whipping up the water, and as suddenly subside.

We could have stayed for hours without a moment's boredom, but we had other fish to fry and once more Jim Vincent was speeding the punt through the reeds towards the marsh. As we went across the marsh lapwings and redshanks circled round overhead, with plaintive cries, anxious for their youngsters. We met a young redshank, a most captivating baby, very

conscious of his long shanks, and very glad to run away from us as soon as possible. We walked to some rough ground where a short-eared owl had her nest, but before we reached it we saw a small form crouching among the bracken, and picked it up—a fluffy bundle of fury, whose bright golden eyes wished me no little ill. He melted somewhat to my pleadings but when I put him carefully on the ground, lay on his back and pointed his claws at the world in the usual owl attitude of attack. In a nearby thorn-bush we found a red-backed shrike's nest and within ten yards of it a nest of vociferous jays.

As we walked back to the Lodge I saw a small dead body on the path and picked it up—a lesser water shrew—with nothing to show how it died. A minute later a swallow-tailed butterfly, the gem of broadland, alighted on a leaf to show to best advantage the loveliness of life.

And so to bacon and eggs, and at nine o'clock already the day was changing, a cold wind had sprung up—rain was coming in the distance. But we had stolen a march on a grey June and snatched some golden hours when most of the world was asleep.

The Kite in Wales

By Eric Hardy, F.Z.S.

AMONG the many effects of the trouble in Spain is the holding up of an interesting experiment to save the last remaining British kites from extinction, in Wales, where nesting pairs had dwindled to less than half-a-dozen. A party of Liverpool and Welsh naturalists, realising the futility of present methods of protection owing to the danger of in-breeding, began an experiment

of introducing eggs of Spanish kites and putting them in the nests of buzzards in Breconshire. Although in the past thirty years Welsh kites had reared about 107 young, many of these fork-tailed birds of prey—scavengers of offal and feeders on rabbits, leverets, rats, mice and chicks—have been shot or poisoned as "vermin" by the farmers or keepers, and carrion-crows and other vermin have plagued their nesting haunts so that there was no doubt about the precarious position of this famous British bird in our countryside.

Under the arrangement of Mr. C. H. Gowland, a scheme was evolved in 1933; certain Spanish peasants in the Coria district of Spain, where nests the kite, *Milvus milvus* ("Milano real" as the Spaniards call it in distinction from the black kite or "Milano nigra" which also nests in their country), were met by a naturalist from Seville in order to arrange for the collection of fresh kite eggs immediately they were laid, but before the birds commenced incubating them, so that, with great care, they could be rushed to England in a fresh condition. This naturally meant the constant observation of a number of pairs of kites until they began laying. The natives argued loud and long over their terms, and despite the generous offer of three pesetas an egg, plus a bonus of a peseta or two for each egg that eventually hatched out, the natives, led by "Miguelito," demanded under the new laws a contract from February 20th, 1934, to the end of March, at 20 pesetas a day wages, while their syndicate or trade union also demanded 25 per cent. to cover risks, etc., so that their charges were really 950 pesetas without any guarantee about the eggs! That gives some idea of the changed situation in Spain, for a few years before the same natives charged only a peseta for a kite's egg. However, agreement was finally made and on April 9th, 1934, news came through from Seville that thirteen kite eggs, carefully packed, had been despatched by a German air line to Barcelona, *via* Madrid, whence they would be picked up by Air France for transport to Liverpool.

Unfortunately, when these eggs arrived tests soon proved they were infertile and no use for the experiment: despite the months of correspondence and detailed guidance, the eggs had inadvertently been packed on end. Some had obviously been gathered after the kites commenced incubating, and having been four days in transport with the yolk in the one position, it was hopeless to expect results from that batch. A second batch, however, was quickly arranged for, and these, packed flat, duly arrived and were rushed by road from Liverpool to Wales. It seemed a little doubtful if the natives had gathered all these as soon as laid, but the best were placed in buzzards' nests, usually two or three in a clutch, on well-known estates at Garth, Breconshire, some

distance from the usual kite country. Only one lot of these hatched out, it is believed, so that further supplies were arranged for the following year. There was also much trouble on this side of the experiment, for buzzard nests had to be kept under constant watch to make sure when they were incubating; if the Spanish birds proved much earlier the eggs might have to be kept a short while in an incubator. In Spain, 1934 was a bad season politically and meteorologically. Heavy floods seriously handicapped the native collectors, and the chief collector, Miguelito, had a bad fall from his horse when returning with eggs, necessitating his lying up. His "syndicate" wanted to know who was to pay his wages while he lay abed under the doctor's care! A June letter from Seville reported "serious troubles are taking place. I have not been able to communicate with Mig. ever since the strike started, shooting and killing is the order of these days."

Eggs Sent on Horseback

Repeatedly those arranging the supply of kite eggs in Spain complained of their increasing fear of the "communists" who even demanded telegrams be sent to England in their presence to make sure the natives would get their future wages. Fortunately, on March 29th, 1935, a code telegram came through that ten kite eggs had been despatched for London on the Norwegian steamer *Mars*. These eggs were handed over to the captain who personally turned them over each day to keep them fresh and fertile. They had been rushed on horseback to Seville within twenty-four hours of being taken from the nest in Coria. Seven of these ten arrived in suitable condition and were placed in buzzard nests in the same way as in the previous year, and it was encouraging to see later in the year from the presence of young kites in the vicinity that one or two clutches had proved successful. It was hoped to repeat the experiment in 1936, but there was no means of getting into touch with the original helpers, so that those who have subscribed to the scheme are forced to wait until peaceful times or try to arrange for supplies from another country.

The whole idea of the experiment was to bring back to the countryside a once common object, now rare, that did little if any damage and would prove a delight to thousands of nature-lovers. In Elizabethan times the kite was one of the commonest of birds-of-prey and scavengers all over the countryside, nesting in Hyde Park and perching in rows along London Bridge. As the countryside became cleaner and sanitation improved this scavenger and feeder on offal naturally decreased. There was no danger from persecution at that time: it decreased simply because the changing countryside did

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not suit it. It retired to those places that remained wild and desolate and with plenty of its natural food. As these became scarce, so did the bird, and then the danger of persecution by gun, trap, poison and other menaces began to take serious effect on its future. Between 1837 and 1840, 275 kites were killed on the Glengarry estate alone. By 1896 Wales was the kite's last nesting haunt in Britain, and it ceased to nest in North Wales before 1900. Until 1868 it nested in numbers in the Wye valley, especially at Rhayader, until trees were felled for the Birmingham reservoirs: three years ago the species was reduced to eight nesting pairs.

Elusive Merlins

By E. W. Hendy

THOUGH for three years past we had seen young merlins on the moor, after they were fully fledged and strong on the wing, never yet had we found the nesting place. This spring we decided to try hard to discover it. Such a search would, we knew, be difficult, for those keen little falcons are most elusive, and the local race has acquired the unusual habit of nesting not on the ground but in some arboreal nest of crow or magpie. No doubt this idiosyncrasy has protected them against foxes and badgers, and even to some extent against the kleptomaniac egg-collector.

In mid-May I put up the jack (cock) merlin from a stone in a clearing where the heather, burned a few years ago, was still short. There were many castings—pellets of feather and infinitesimal bones—round the stone, and further on was the corpse of a slaughtered meadow pipit. He circled high, his vivid blue plumage glinting in the sunlight, until I lost him against the sky. A week later I walked the area carefully: a hen-harrier glided past me as I approached the clearing, but though I again found castings, I saw no merlins. Early in June I once more caught a glimpse of the jack coasting with spasmodic wing-beats along the edge of woodlands that fringe the moor, but he gave me no clue. A few days later I had, for the first time, a distant view of the hen, but she performed the vanishing trick as completely as her mate.

Next time the scent was stronger, for we roused the hen merlin from her kill of a cock chaffinch, and she keened "kee-kee" in shrill anxiety. Evidently there were young somewhere about, but we searched for them in vain. Two days afterwards she again flew up near the same spot and circled round, bitterly complaining. We watched for an hour and more, and in the distance saw the jack pass prey to her in the air: his cry as he met her was more plaintive than her harsh alarms, but once more she eluded us. Tantalised by these happenings

we came the next day: three times did we see the hen but again we returned baffled. In early July I determined to solve the mystery if I stayed out all day. Again the hen got up where we had so often seen her. Her cries were redoubled, and she seemed more anxious than before. Soon after the jack appeared, but both birds vanished in a dip of the moor below me. Later, I heard the hen "kee-keeing" below me and to the left. Walking towards her, I espied a tiny piece of white down tangled in a sprig of heather. Advancing into the wind I found another fragment of fluff, then another. Scent was growing hot. After some fifty yards, this feathery trail led me to a scattered patch of white down in a heathery dimple. From it two fledged young merlins rose, and flew unsteadily up the hillside.



A male merlin brooding. Photograph by Frances Pitt.

And in the heather was yet another youngster—crouching over the head and wings of a plucked goldfinch!

He was a lovely bird. Though unable to fly, his featherage seemed complete. The dappled brown and grey plumage of his back and wings was powdered with a bluish sheen. His orange legs and feet were tipped with jet-black claws. And then his large dark eye, wild and fierce and defiant! Handled, he turned on his back and menaced me with claw and beak; but calmed down as I stroked his head. Spilt down led me to another dismembered goldfinch, and eventually to the original nesting place, beneath tall heather, by a fir sapling; there was an addled egg trodden into the ground. Evidently the eyasses, as they grew stronger, had fluttered away out of the "nest." Calculating backwards over the incubation and fledging periods, it appeared that when I first put the jack up in mid-May the hen must have just begun to sit. We must have often passed within a few yards of the "nest."

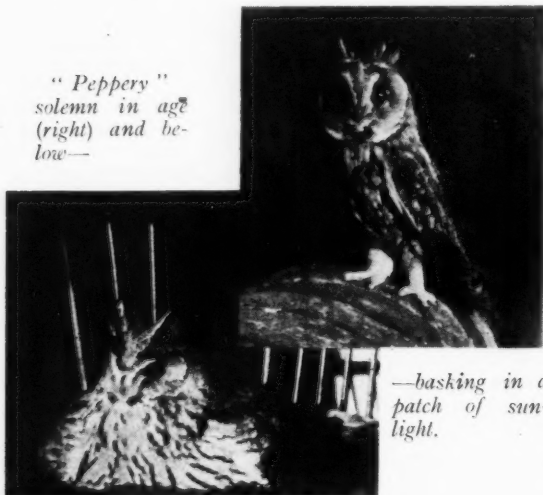
A Domestic Owl

By W. H. Payn

HE is a long-eared owl, an Ulsterman, born in an old crow's nest from which one June day he accidentally fell, to be discovered by a keeper who carried him home in the crown of his hat. He was still sitting there when later I was introduced to him—a round, soft ball of grey fluff, with eyes like twin globes of orange fire, a naked bridge to his nose which glowed pink with indignation, and a head as round as a tennis ball, surmounted by a pair of ridiculous little knobs of fluff.

From the first he was friendly and good tempered, and the name "Peppery," bestowed upon him early in life from his habit of clacking his beak and hissing at strangers, is really a gross libel on a charming and gentle little bird. A fortnight after his capture, "Peppery" and I crossed together to England on a rough night when we were both taken extremely unwell.

"Peppery"
solemn in age
(right) and be-
low—



—basking in a
patch of sun-
light.

The long railway journey to London was accomplished in a cardboard box in the rack, whence he mystified our fellow travellers by emitting at frequent intervals a series of loud and penetrating sneezes. A week more he spent in a tool-shed in Hampshire and so at last arrived, a much-travelled bird, in his present quarters.

As he is fond of company, I always have him with me during the day, in my sitting-room, despite the fact that his antics there seriously interfere with my work, for there never was a more inquisitive bird. At first he was greatly interested by everything in the room. Every article of furniture must be examined with beak and foot, the table-cloth must be fiddled with, the contents of the coal-scuttle examined.

Having now reached years of discretion, he is more

sophisticated and less amusing, but even so he cannot bear to be left out of anything and any strange noise or movement immediately rouses him to action. A blue-bottle fly buzzing at one end of the room calls for investigation and a little rather solemn playing with beak and foot, and then he sees someone opening a drawer or cupboard and, gathering his skirts about him like an old lady in a gale of wind, he comes hop, skip, skip across the carpet, to stand close by with a ridiculously puzzled look on his face while, for the better elucidation of the mystery, he must turn his head repeatedly from side to side, sometimes screwing it right round till his beak points to the ceiling—a remarkable performance. Much of his time is spent gazing out of the window, and every car and passer-by on the road outside calls forth a thoughtful "oo-u."

Between "Peppery" and my dog a state of armed neutrality exists; when the dog wants to play, "Peppery" is very much on his dignity, but should he discover the dog asleep, he cannot resist flying down and gently tweaking his ears and tail; yet there is really no hostility between them, for often dog and owl are asleep together side by side before the fire. "Peppery" is puzzled by the fire and though, since he walked into the ash-pit and a hot coal burnt his tail, he has kept away from the grate, he loves to sit for hours on the fender, toasting himself before the flames. He likes, too, to bask in the hot sun; when he finds a patch of sunlight on the floor, he throws himself, with a curious shuffling movement and a low hoot, forward upon his breast and there, spread out quite flat with wings open and ear-tufts erect, lies in a kind of trance for half an hour at a time.

"Peppery" possesses a great appetite but is fortunately easy to feed, rabbit flesh, young rats, mice, bats, fish, sparrows all being equally acceptable. Sparrows are plucked and devoured piecemeal; a mouse is held in one foot, the head is twisted off and swallowed and then the whole body follows in a few rapid gulps. Shrews and large birds are played with and left uneaten. On the whole he is a silent bird; as a baby he made a noise like a badly-oiled door hinge, but now he has only a low hoot of contentment and—apparently—of surprise, and a loud flight-note "oo-ack, oo-ack" like the quacking of a duck.

When I take him back to his home at night, he flies round and round with his wing-tips just brushing the walls of the stable, while he utters his flight note and waits for me to throw him his rations. Should he, however, find a broody hen in one of the mangers, he will think of nothing else until he has stirred her up and sent her into screaming hysterics in some dark corner. Then he goes happily to bed.

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The Real Future of Television.

By Alan Chappell

Television, like all technical matters, suffers from a great deal of popular misapprehension. In this article some of the fallacies, such as the long-distance transmission, which many expect, are revealed, and a sober opinion of the future of television is pronounced.

WHEN the B.B.C. inaugurated the British Television Service on November 2nd, 1936, television in this country was considered to have started its working life. After years of experiment it had achieved official maturity. It was only natural, therefore, that the debut of a new science possessing such vast and spectacular potentialities should raise the question: What of the future? Television's rapid development to its present state of technical excellence justifies great hopes for it. But it would be of benefit both to the new science and the public alike if the practical possibilities of television were stressed a little more, and if some of the imaginative prophesies which have gained a hearing recently were believed a little less.

It has, for instance, been assumed by many and stated by some that within a reasonable number of years, long-distance transmissions, even across the Atlantic, will be broadcast regularly. That the layman, knowing the vast range of radio, should believe such a thing possible is natural enough. Even a slight knowledge of technical problems, however, reveals a different path of development for television, although one just as complete and attractive as the sensational theories predict. The truth is that long-distance television of the type we know to-day, is never likely to be practical, or even possible. In high-definition transmission (regarded by research workers as the only satisfactory form) the

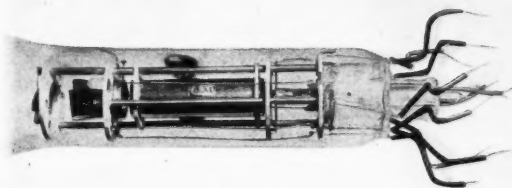
Although present-day knowledge does not indicate the establishment of regular long-distance broadcasts, experts do foresee an inland television service in Britain, providing a far greater coverage of the country than is now possible. Efficient high-definition reception is at present limited to within a radius of about 30 to 40 miles of the transmitting station. Undoubtedly this figure will be increased in the near future, but not so much as to cover really long distances.

Many television engineers believe that the best way to overcome the distance problem and to establish a complete national service would be to build a chain of stations throughout the country. Each would have a double function. Firstly, it would be able to relay from a central transmission station, such as that at Alexandra Palace, and, secondly, to give individual programmes of its own. Inevitably, much of the popularity of television will be linked up with the development of outside broadcasting. This technique has made rapid strides within a comparatively short time, and the progress of television will be an incentive to develop it further. It has been suggested in trade and official circles that an effort be made in the future to popularise television by showing television programmes at news cinemas at regular hours. Audiences would thus be able to see all types of events while they were actually in progress.

It should be added here that outdoor transmissions on a large scale are already possible. In a recent television programme from Alexandra Palace, a famous cowboy actor rode his horse round an arena, going sometimes to a distance of 150 yards from the television cameras. At all times during this transmission, reception was clear. Before the cinema scheme can be put into practice it must be possible to project television on to a large screen. This is already being done by two methods. One is a method in which there is a constant source of light, and the picture comes through a



A standard di-pole G.E.C. receiving aerial for television.



The electrode assembly of a cathode-ray tube.

waves are limited to the optical range. Hence reception can be "screened" by curvatures of the earth. And the only way to broadcast programmes across great stretches of water would be to relay them from the transmitting station by land line. But since the cable used costs about £1 per foot, and to lay it involves a vast amount of labour, this method is not likely to be far developed.

mechanical scanning apparatus. That is all that can be said about it at present, though further details will be revealed when it is put on the market in a few weeks' time.

The other method is by a cathode-ray tube (which plays a very important part in television and will be described later). The image is produced at the end of the tube; up to that point only electrical processes are used. But to convey the image from the end of the cathode-ray tube to the screen, an optical system (making use of a suitable lens) is employed. This projection through lenses presents no great difficulty, except that insufficient light is available at its present stage of development. Research workers, however, have this problem in hand.

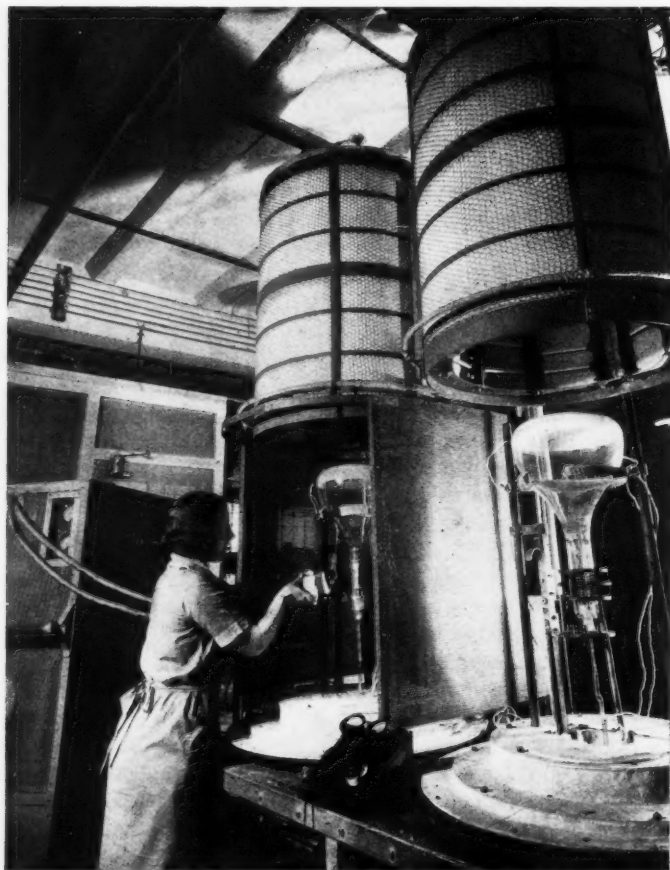
Two phases of television which open limitless entertainment possibilities are colour pictures and stereoscopic vision. Both are already the subjects of

experiment, though the nature of these cannot yet be revealed. No commercial developments have been made, but some of those who are working on colour processes are sufficiently pleased with results obtained to think that television in colour will soon be abreast of cinematograph pictures in colour.

On the whole, gradual progress without sudden sensations is what we may expect of television in this country. Technicians do not visualise a sudden fall of prices to the level of modern radio sets. Rather do they foresee steady technical progress, showing itself chiefly in the increasing size of the screen on which pictures are received, and prices adjusting themselves to the growth of the television market. Research work on receiving sets has been carried out for a number of years by private firms; and their discoveries, moulded into practical form, now constitute the nucleus of what is likely to become a prosperous and thriving industry.

An immense amount of labour and materials is put into the manufacture of television sets. In the standard 23-valve G.E.C. set, for instance, there are not less than 3,980 parts, all of which are made by the company. An alternative set incorporating an 8-valve all-wave sound receiver carries a further 2,000 parts. Nor, indeed, is this bulk of work the only production problem. The processes of manufacture are complex and delicate. In the G.E.C. research laboratory at Wembley is a room claimed to be as free from dust as any room can be. In it are made the screens on which the television image is received. The screen is coated with a powder consisting of zinc sulphide and other chemicals. When the powder is bombarded by electrons it lights up and it is in this way that the picture is obtained. But it is essential that the layer of powder be absolutely even, and that is why there must be no speck of dust in the room. Incidentally, when the electrons bombard the screen they are travelling at a speed of 70,000,000 miles an hour.

The electrons are directed through a cathode-ray tube, and the screen is actually the flattened end of this tube. Because the electrons travel through it at such an immense speed, the shape of the tube has to be mathematically worked out so that it can withstand the strain imposed upon it. Before being passed as fit for use every tube has to undergo a water-pressure test of over two tons. From the cathode to the screen



Exhausting a cathode-ray tube, a process in the manufacture of television sets at the G.E.C. laboratories at Wembley.

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the tube is 28 inches long. For the first half of the distance the sides are parallel, later widening out into a pear shape. When the screen has been powdered, the cathode is fixed at the thin end of the tube. To speed up the beam of electrons, an electrode of high positive potential is placed along the tube. A converging electrical field, half-way along the narrow part of the tube, forms a lens to focus the beam.

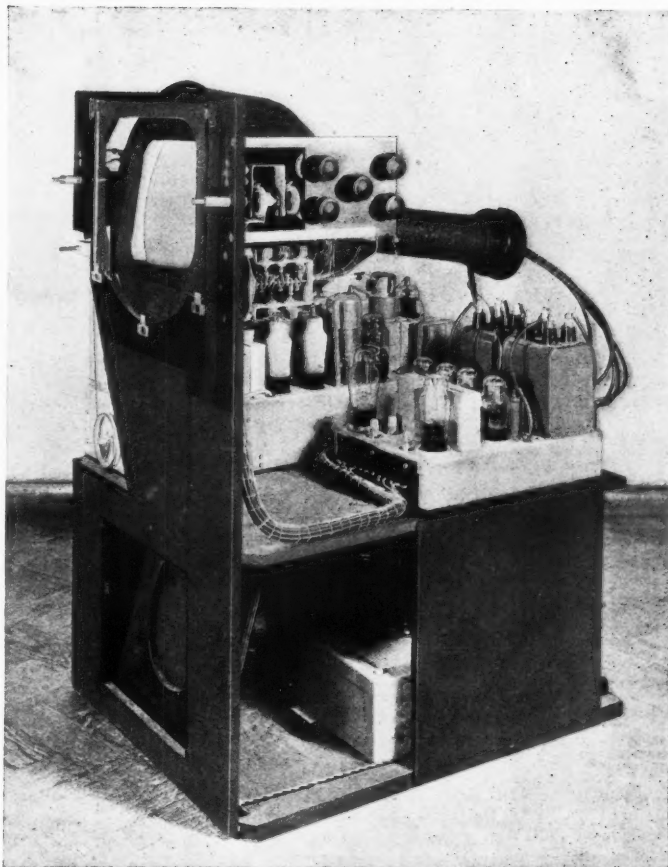
At the position where the tube widens are two further electrodes, which act as "electric deflectors." They enable the fixed electron image to be placed horizontally in the range of 6,000 or 10,000 line-repetitions per second. Vertically, the repetitions take place at the rate of either 25 or 50 per second, giving that frequency of images, so that the instrument can be immediately adjusted by the turn of a switch to accommodate either of the two transmission systems which are at present being alternately employed by the B.B.C. transmitter.

Large Screen Television

Pictures transmitted by Baird television from a studio within the building were shown on a screen 8 ft. by 6 ft. at the Dominion Theatre recently. Flicker, "rain" and a rather dim appearance make the demonstration noticeably inferior in quality to that obtained with the small screen television receivers now on the market. Optico-mechanical methods giving 120 line multi-mesh scanning with 17 frames a second are employed. For production of the screen image a high intensity automatic arc is being used.

High-vacuum Cathode-ray Tube

Among the exhibits at the Physical Society 1937 Exhibition at the Imperial College of Science was an unusually high-voltage, hot-cathode, high vacuum sealed-off cathode-ray tube to operate at voltages up to 15 kV, manufactured by the Edison Swan Electric Co., Ltd. The use of this high voltage, coupled with the special screen material used, enables visual observation and photographic recording of rapid transients. Low-capacity deflector plates are used with a simple scheme to trap the beam at the end of each sweep. An experimental high-vacuum cathode-ray tube was used to show the divergence of the beam from a "jet" type anode, through a magnetic focusing coil and its subsequent convergence to a focus at the screen. The



The side view of the 23-valve G.E.C. television set.

effect of variation in focusing field, anode volts, etc., could easily be observed.

Range of Television Reception

Television receivers are being installed at points far outside the circle with a radius of 25 miles from Alexandra Palace, which was expected to prove about the limiting distance for satisfactory reception of ultra short-wave visual transmissions. At Cambridge and Brighton, 50 miles away, and at Reading and Southend, receivers are being successfully operated. Even at points where intervening high ground might be expected to obstruct the signals reception has proved possible. It would seem that a fair number of receivers are being installed in the Home Counties outside the Metropolitan district proper, and it is very important that the programme matter should be of a kind likely to maintain interest in the service so that there shall be no check to the development of a public for television.

A Psychologist in the Special Areas

By Capt. J. H. Blaksley, M.C., M.A.

National Institute of Industrial Psychology.

To the practical man few things are more distressing than misdirected charity, especially in cases where real help is an urgent necessity. Recent discoveries in industrial psychology have made it clear that the Special Areas in Great Britain present a peculiar psychological problem, and a plea is made herewith for the co-operative use of these discoveries to attain successful results in solving that problem.

It is common knowledge that the condition of the Special Areas is the great blot on our domestic recovery. But it is not always realised that the plight of these districts is only an extreme example of the tragic results of large-scale displacement of labour. Before the War our unemployment was mainly due to temporary trade depression and to the drift of men from their work through age, incapacity, or laziness. Since the War, invention, rationalisation, tariff protection, and world depression have confronted us with the new problem of the work leaving the men for good and all. This is a problem of great national significance and it is more and more on people's minds. In the course of my lectures to industrial audiences in South Wales and other parts of the country, I have found that about half of the questions put to me bear on this subject in one way or another. In certain districts the all-important primary industries, like coal and shipping, have been the victims of circumstances over which they had little or no control, with the result that secondary and tertiary industries have crumpled and retail trade has dwindled to insignificance through lack of local purchasing power. Such are the districts officially described as "The Special Areas."

Old Industry Dead

In the short view their problems are seen to differ in degree rather than in kind from those of other districts, like parts of Lancashire, where, also, serious depression has befallen the primary industries. But there is the distinction that, whereas in these districts there is hope for some recovery in the old industries with a general recovery in world trade, in the Special Areas much of the old industry is dead and has no hope of being reborn. It is this factor which makes the four Special Areas—South Wales, Durham and Tyneside, West Cumberland, and South-West Scotland—the outstanding sociological problem of the day.

Sociology is the child of economics and psychology, and social legislation may be likened to the well-meaning relation anxious to help from outside. Our mistake in the 19th century was to treat sociological problems as the offspring of economic conditions alone; and

even now we are only beginning to appreciate the value of the systematic study of the personal element in occupational life, in order to redress the balance of the exclusive economic approach and to combine in sociology due regard for economic laws with due recognition of human values. Like other new ideas, the applied science of industrial psychology has suffered from the attention of cranks and faddists, but its proved results now show that if it is used as a supplement to the older sciences and to ordinary common sense it has a great contribution to make to industrial and national well-being.

There are the two distinct aspects of the problem of the Special Areas, the economic and the psychological. The first is admittedly the more pressing, but in spite of the expenditure of much effort and a considerable amount of money, little progress so far has been made towards economic recovery. Practical interest in the psychological aspect has been restricted mainly to the philanthropic activities of untrained individuals and charitable societies, assisted in some cases by grants from the Commissioner's fund. Yet, with the progressive deterioration of manhood, the psychological approach (which includes the physiological) is in itself a matter of grave national concern, and the importance of the human element in the resuscitation of old industries and in the attraction of new ones makes this line of approach a factor of direct economic value to the Special Areas themselves.

The Four Ages of Unemployment

The victims of enforced idleness fall into four main divisions. First, there are the children growing up in an atmosphere of chronic unemployment, where a man in full and regular work is an object of curiosity; secondly, the young people who have never been in work; thirdly, those who have lost their jobs but hope to find others; and, fourthly, the middle-aged and the elderly who know in their hearts that they will never work again. In each of these divisions the majority still possess the will to work in varying degrees of intensity, but the number sulkily reconciled to a life of idleness is growing every day. No doubt the first two categories constitute the most serious problem; but from the human point

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of view there is something infinitely pathetic about the fourth—that men with knowledge and experience behind them, still, perhaps, at the height of their mental and physical powers, should feel themselves doomed to live for the rest of their lives as useless parasites on the community.

We must remember, too, that the inhabitants of the Special Areas present distinct psychological problems from the very nature of their circumstances. In many cases their natural desire to be active has atrophied, and their ambition has been sapped. Their power of self-mastery has been weakened, and their capacity for self-adjustment undermined. Such men are naturally resentful, suspicious, and difficult, and they cannot be treated in quite the normal way. It is sympathetic understanding that they need, with just but kindly leadership. There were no better soldiers in the War than the miners from the pits of South Wales.

What then is actually being done, and how can it be supplemented from the psychological side?

We have yet to see the proposals of the Government's new Bill and the ways in which Lord Nuffield's trustees will use his munificent gift of £2,000,000. But, so far, effort has in the main been concentrated, firstly, on Government contracts, public works, and the various attempts to attract new industries through Industrial Development Councils, Trading Estates, and Trade and Development Associations working in co-operation with the District Commissioners; secondly, on training and instructional centres, the transference of labour out of the Areas, and settlement on the land; and, thirdly, on social amelioration through a special milk scheme, a special housing scheme, and the encouragement of camps and social centres through the agency of the National Council of Social Service.

Abnormal Difficulties

In the whole task of reconstruction, the economist and the industrial psychologist should be working hand in hand, especially in view of the abnormal difficulties of the human problems resulting from long unemployment. In spite of direct financial inducements and the advantages of cheap land and abundant labour, boards of management hesitate to build factories in the Special Areas because of their belief that the labour is demoralised and aggressively communistic. Thus the psychological problem blends with the economic, and suspicion, the child of misunderstanding, is retarding economic recovery. There is wide scope for the industrial psychologist in the giving of expert advice on the selection, training, and handling of the work-people. Nothing contributes more to good morale than providing people with the work for which they are fitted by

temperament and aptitude. It is the misfit and, what is far more common, the partial misfit, who grows discontented through being consciously or unconsciously thwarted. Scientific research has now made it possible to prevent to a very large extent the engaging of unsuitable men and women and to avoid thereby the costly and demoralising process of elimination by trial and error. In one case, for example, after the introduction of selection tests, the proportion of misfits in a certain firm was reduced from over 20 per cent. to less than 3 per cent., and in another instance, labour turnover was reduced from over 50 per cent. per annum to about 10 per cent. per annum.

Engineering Aspects

In the planning of new factories which are likely to be erected in the Special Areas, the engineer and the industrial psychologist should work in the closest co-operation so as to ensure that, both in the general lay-out and in the smallest details, due regard is paid to the view-point of the men who will actually be doing the work. Not long ago I visited a factory beautifully equipped from the engineering point of view, and the managing director showed me with pride the new lighting system which he had installed at great expense. At first glance it looked perfect, with an ample number of lights above the heads of all the girls employed. But the work in this factory was fine work and each girl had to bend forward to see what she was doing. The result was that her right shoulder threw a shadow just in the wrong place. The lights were about six inches too far back throughout the room. The managing director confessed that he had never noticed this, and it had completely escaped the attention of the lighting engineer.

Another field for psychological investigation in many parts of the Special Areas is in market research, where methods of sale and customers' psychology need to be examined side by side. One welcome result of a revival of industry will be the revival of local retail trade. But customers' tastes and habits will have changed in the long years of depression, and as recovery comes, retailers without resources behind them will need to know the directions which new demands are likely to take.

Akin to this is the psychological question of publicity and advertising with a view to making the most of existing amenities. Last summer I spent a few days' holiday on the coast of Belgium and on my return my work took me to South Wales. Here I found a coast about the same distance from London but facing south instead of north, with equally good bathing and equally good sands and with a hinterland of hills far more beautiful than Belgium. Even the groups of

factory chimneys which are dotted about South Wales looked attractive in comparison with the hideous rows of Belgian *pensions*. But while Belgium was a hive of tourists, South Wales was practically deserted except for daily trippers. Such is the psychology of fashion and the result of clever publicity.

Selection for Transference

A more direct and perhaps a still more important field for the trained psychologist is in the selection of applicants for transference to other districts. Mr. Malcolm Stewart, the former Commissioner for the Special Areas, said in his First Report (§ 171) that transference is essential "for an appreciable proportion of the work-people in parts of the depressed areas . . . if they wish to gain their living," and he added, "I am certain that the policy is workable." But up to the present the schemes which have been put into operation have met with limited success. Too often employers complain that the transferred workers are unsuitable, and far too many return home after failing to make good in strange and uncongenial surroundings. Still more skilled attention is needed in the selection and training of applicants for the life and the work they are going to, and still more effort must be made, both before and after their transference, to overcome the timid and negative attitude of mind that develops with years of idleness around the subsistence level. With transferees, as with emigrants, qualities of character and of temperament are as important as technical aptitude in determining success or failure.

A form of transference of particular interest at the present time is land settlement, and here again the psychological aspect is as important as the economic. It is common knowledge that good land and good marketing alone will not make small holdings a success; the settlers and their womenfolk must be suitable by temperament and aptitude, and like the Danish farmers be prepared to make their work their life. The Land Settlement Association indeed have admitted that their greatest problems are connected with the human element. The whole case, moreover, for the scheme of subsidised settlement is psychological in conception. Its chief purpose is the rehabilitation of manhood, not the economic production of wealth, and even when allowance is made for the saving of unemployment pay it can hardly be hoped that the holdings will ever return in terms of money the full cost of their establishment and supervision. It is, therefore, all the more important that we should know—as far as research can tell us—what the effect of life on a holding is on the minds and characters of an unemployed man and his family, and how far the different types of land settlement are achiev-

ing the desired result of restoring morale and physique at the minimum cost to the community.

There remains the immense problem of arresting moral, mental and physical degeneration in the Special Areas during the slow process of reconstruction. In an article in the *Human Factor* of November, 1936, Mr. C. A. Oakley, the Director of the Scottish Division of the National Institute of Industrial Psychology, analyses the various stages of demoralisation resulting from unemployment, and he expresses the opinion "that the problem is largely summed up in the term 'self-respect'." By studying this all-important factor and by tactful observation and advice the practical psychologist could make a valuable contribution to the admirable and self-sacrificing work now being done by charitable individuals and local societies, and at the same time he could help to check the waste and diffusion of energy which inevitably accompanies undirected voluntary effort. In juvenile and adult education also, both mental and physical, there is a particular need for the co-operation of a psychologist in view of the demoralising environment. Education worthy of the name means the nourishment of the whole personality. Throughout the Special Areas, and in South Wales in particular, genuine interest exists in the industrial questions of the day amongst the leaders of thought, whether they are at work or not, and a talk on some of the aspects of the personal element in the problems of work and of leisure will generally attract a keen audience. It is of vital importance in a democratic community to try to satisfy the demands of enquiring minds, and there is no better way of promoting confidence and mutual understanding than by bringing together employers and employed in a discussion of general principles which apply by implication to the particular problems of individual industries and individual firms.

The Psychologist's Harvest

There is but one conclusion to be drawn from this brief survey of our subject. It is not a question of whether or not the industrial psychologist is needed in the Special Areas, but of where he ought to begin in so vast an untitled field. The idea that he could in any way supplant the economist or the various technicians is simply out of the picture, and there could be no question of his wishing to divert large sums of money from the work of material reconstruction. But if one per cent. of the amount annually expended on the Areas could be devoted to the psychological approach, it would not only be more than recovered in direct material returns, but in human morale and in human happiness it would yield a still greater, though an inassessable, harvest.

The Great Iceland Geyser

By Olafur Sveinsson.

The resuscitation of an extinct geyser may seem an impossible feat, but in the article which follows, the story of the conversion of a stagnant hot spring into a geyser rising 120 feet into the air is told by one who was closely connected with the work.

A MIRACLE of a modern kind has recently happened in Iceland. A miracle of nature, wrought not by nature alone, but by the co-operation of nature's forces and human intelligence; a miracle that can be controlled, explained and, above all, promises possibility of repetition. The Great Geyser of Iceland has been resuscitated after more than twenty years of inactivity and apparent "death." The ancient patriarch of the North has thrown off the fetters of old age, and is now as vigorous as in his prime!

The instigator of the novel enterprise, which terminated so successfully, is a police-constable of Reykjavik, Mr. Jón Jónsson. A country-born lad from the close vicinity of the Geyser, his cradle had, so to speak, stood in the spray of its play, and the first sound of the big outside world that reached his ears was probably the boom of its outbursts. During his boyhood the one spectacle of his life was the glorious display of the Great Geyser once or more every day. It strikingly illustrates the fascinating influence of the Geyser in its prime, that the people of Laug, his father's farm, who were, of course, quite seasoned to the sight of its play, used to rush on to a knoll in the home field, if they were working outside, to obtain a view of the eruption, immediately the subterranean rumblings started.

As the years went by, the frequency of the outbursts lessened, and by the time Mr. Jónsson left home, the Great Geyser had practically ceased activity, and could not be stimulated to life, even with a hundred-weight of laundry soap—the usual stimulant. The last

great eruption was observed in 1914—about the commencement of the Great War.

Mr. Jónsson often racked his brain about the cause of Geyser's altered habits, but never came to a definite conclusion. So the years went by, and the glory of the Great Geyser passed into oblivion, and in the public opinion it was regarded merely as an object of historical interest.



A normal eruption of the Great Geyser.

In the meantime, Mr. Jónsson had grown to manhood, and went to Greenland as a member of the famous Wegener Expedition, which did research-work upon the inland glaciers of Greenland, and remained there one year and a half. Back he came to Iceland again, and took up the calling of a policeman at Reykjavik, a post he has held for several years. During all these years the problem of the

Great Geyser had often crossed his mind, but without results. While in Greenland he was sometimes reminded of its comfortable warmth in contrast to the cold camps upon the flanks of Greenland's great glaciers, where the main heat producers were healthy activity and high-toned vitality.

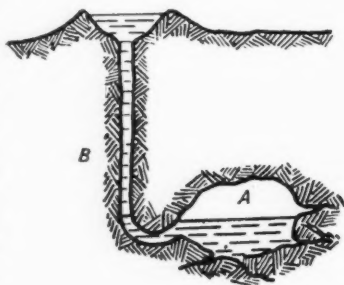
In the winter of 1934-35 one of the most frequent topics of the local Press was the importance of adopting some means to attract foreign travellers to Iceland. It was in the course of a conversation with an acquaintance—a man of great intelligence—on this topic in general, and the resuscitation of the Great Geyser in particular, that Mr. Jónsson had a brain-wave about the problem that had so long been in his mind. He

recollected having heard, many years ago, that his grandfather had succeeded in getting an eruption from an extinct geyser, in the vicinity of the Great Geyser, by baling it out.

He went to a friend of his, Mr. Gudmundur Gíslason, a physician—who had likewise been a member of the Wegener Expedition—to lay the matter before him, and obtain his aid, if possible. Mr. Gíslason, who is now engaged in research work at the laboratory of the University of Reykjavík, became interested in his friend's idea and promised him his help and co-operation in the matter.

The next step was to make preliminary investigations about the physical conditions and probable changes in the former geyser, with a view to determining the cause of its changed behaviour. Plenty of data was available for comparison from the Great Geyser's time of glory, the nineteenth century, among which the researches of Professor Bunsen, the famous German chemist, were the most extensive. Accordingly, a third member of the party, Mr. Einarsson, went out to the Geyser group—about 60 miles east of Reykjavík—and stayed there for ten days, making tests and taking measurements in the Geyser hot spring. The investigations clearly showed that great changes had taken place in the old geyser since Professor Bunsen made his measurements, about the middle of last century. The diameter of the basin was now 49 feet, whereas Professor Bunsen made it about 60 feet. The funnel—which is a vertical cylinder—had the same width as before—10 feet—but 20 feet from the rim is a ledge, where it narrows down to about 5 feet; the total depth from the rim being about 52 feet. Professor Bunsen makes the depth 65 feet, and an even width from the upper orifice down. From

A cross section of a geyser. A is the space in which the steam accumulates, and B the funnel by which it finally escapes, throwing the water in the basin at the top violently into the air. Reproduced by the courtesy of "Tímarit Verkfræðingafélags Islands."



this it was obvious that the basic structure of the former geyser had changed markedly. But the most significant change was the thermal one. The surface temperature in the basin was now 60-65° Centigrade, and at the bottom of the funnel, 113-118° Centigrade. When

Professor Bunsen made his measurements, the temperature was 80-90° and 125-130° respectively.

In order to continue operations, it was now necessary for the friends to obtain permission from the owner to make the necessary alterations on the former geyser so as to test the soundness of their theory. The geyser group of hot springs was owned by an Englishman, Mr. H. I. G. Rogers, having passed into ownership of a compatriot in 1894 for a trifling sum. The friends received the information through an acquaintance, that in all matters relating to the Great Geyser they were to consult the owner's agent in Reykjavík, Mr. Sigurdur Jónasson, a lawyer, and director of the Tobacco Monopoly of Iceland, which they accordingly did. Mr. Jónasson became very interested and immediately granted the required permission, which was also sanctioned by the Prime Minister of Iceland, Mr. Hermann Jónasson. Both these gentlemen promised their support, and showed great enthusiasm and interest for the undertaking.

Here is the account of Mr. Jónsson, whose acumen and initiative led to the resuscitation of the Great Geyser, of how the miracle was accomplished. "On the eve of July 27th, Einarsson, Gíslason and myself, with a fourth man, went in a motor car out to the geyser group, with the necessary tools. We commenced work at 10 o'clock p.m., to cut a narrow channel through the rim of the geyser basin, in order to lower the surface of the water in the basin. The night being a clear one, we carried on till 4 o'clock a.m. on the 28th, and slept till seven in the morning. We then started afresh and continued till past noon, when we judged the channel deep enough to serve our purpose, although it was then only a narrow fissure three feet deep. By this time the surface exposed to the cooling effects of the air was only one half of its original size, and the temperature—which had been measured every hour—had, at about 3 o'clock p.m., risen to eruption heat, or 93° Cent. on the surface, and 125° Cent. at the bottom of the funnel. If our theory proved correct, this would be enough to start an eruption.

"In order to hasten the issue we treated the geyser with a double dose—about two hundredweight—of laundry soap, and then waited in tense expectancy the reward of our labour. We had not long to wait; presently a subterranean 'cannonade' and earthquake-like tremor in the ground heralded the approaching eruption, the old giant began to rumble and groan, and bubbles of steam broke the mirror of the surface. By-and-by the water in the basin came into violent agitation, and at 4.15, the Great Geyser tossed the contents of the bowl, like solid matter, into the air with tremendous force. It was magnificent, awe-inspiring,

and yet beautiful, with cascades of sparkling water running down the sides and over the brim of the basin; a pulsating pillar of live steam and boiling water, enshrouded in clouds of vapour. It was a marvellous, a magnificent spectacle, and one never to be forgotten, to watch the tremendous strength of the outburst, when the scores of tons of scalding water in the geyser-basin heaved and surged in violent agitation, rising to a height of some feet and taking on the shape of a cupola, which expanded upwards and telescoped itself with explosive velocity into the air, to reach, in the strongest throbs of the geyser's pulsation, the extraordinary height of 160 feet or more.

"It was a marvellous spectacle for anybody, but for us, who had been instrumental in bringing this about, it was indeed an exalting moment, a moment of inspiration and self-realisation."

This first eruption lasted 15 minutes, during the first five minutes of which it was on the increase; the next five minutes it attained its greatest elevation, and held its own against gravitation most of that period; during the last five minutes the eruptive force slowly spent itself, and it was well past the quarter before all was quiescent again. Fourteen hours later the next eruption came, without any stimulant being applied, and the third, which came after about the same interval, established the fact that the geyser had indeed been rejuvenated by this novel operation. These subsequent eruptions were very similar in force and duration to the first one. Since then, the Great Geyser has taken up its former habits, and keeps on erupting at irregular intervals of one or more days, if left alone. But if treated with laundry soap, it can always be roused to activity, provided a reasonable time (12-15 hours) is allowed to elapse from the last eruption. Cold weather retards, warm weather accelerates the eruptions. In summer the average interval is 12-20 hours.

Some days after the resuscitation, Mr. Jónasson announced the news that he had bought the Great Geyser from Mr. Rogers and presented it to the State as a national reserve. This news was received with enthusiasm by all lovers of Icelandic nature, as indeed it should; the donor is worthy of all praise for his unselfish motive in restoring this remarkable spectacle to the nation. This is the account of how Iceland

recovered, in double sense, this lost treasure of its nature—the famous patriarch of the world's geysers, and the greatest geyser of Europe and of the Old World.

One of the greatest authorities upon geysers was the late Professor Bunsen, who made a special study of the Great Geyser of Iceland. His theory about the mechanical details of a geyser is as follows.

In connection with the lower orifice of a geyser's funnel there exists a chamber or cave in the earth, partially filled with hot water. The connecting opening is in the wall of the cave, below the water level of the cave. "The water, kept by the surrounding furnaces at boiling point, generates a continuous supply of steam, for which some vent must be obtained; as it cannot escape by the funnel—the lower mouth of which is under water—it squeezes itself up within the arching roof, until at last, compressed beyond all endurance, it strains against the rock, and pushing down the intervening waters, forces them below the level of the funnel, and dispersing part, and driving part before it, rushes forth in triumph to the upper air." Professor Bunsen later evolved a more scientific explanation, propounding it thus:

"Water, after being long subjected to heat, loses much of the air contained in it, has the cohesion of its molecules much increased, and requires a higher temperature to bring it to boil; at which moment the production of vapour becomes so great, and so instantaneous, as to cause explosion."

It is obvious, if one accepts these principles as basic laws, that a hot spring, in order to be a geyser, must possess a combination of unusual physical features. It must possess the subterranean cave, in which steam and water can be accumulated; it must possess the funnel which projects the jet and, last but not least, it must possess sources with sufficient heat to generate steam. If any of these features is lacking, the function will be merely that of an ordinary hot spring, and if any parts are impaired, the function will deteriorate relatively. If the functional disorder of the Great Geyser had resulted from structural deformities, such as a lateral cave-in or subsidence of the underlying strata, the attempt at resuscitation would probably have ended in complete failure.



Mr. Jónsson (left) and Mr. Gíslason standing in the empty basin after an eruption. The funnel is on the left.

The Mystery of Ambergris

By N. W. Gregory Walker

In these days of synthetic materials it is unusual to find a "natural" substance withstanding the ingenuity of the industrial chemist. Ambergris, however, with its mysterious faculty of "fixing" any perfume to which it is presented, has so far defied all efforts to reproduce it. Even its composition and its precise origin still remain in doubt.

It would be easy to write romantically of ambergris, if one did not attempt to describe it. It is not, of course, grey amber, though it is sometimes washed up on beaches and, if melted, resembles a gum. By general opinion it is a calculus formed in the sperm whale or cachalot (both male and female). This whale, which can swallow a seal, lives largely on cuttlefish or squid and, as cuttlefish beaks are usually found embedded in the ambergris, it has been suggested that irritation caused by these sets up a morbid condition which causes the calculus to form. Nevertheless, though all sperm whales eat squid, very few yield ambergris.

Some of these calculi are voided by the whale, and are found floating in the sea or washed ashore, though those found must be only a fraction of the whole amount so drifting, even allowing for what is destroyed by sea-birds and fish and crumbled on rocks. The biggest lumps are those taken from the stomach of the whale. Some smaller ones, in "parcels" of 15 to 70 lbs., are sometimes found lodged in the intestines, where they take a ham shape, the foremost one arresting a whole series of others, which are found close behind it. Such half-voided pieces are always smooth, and these obstructions support the whalemen's belief that ambergris in quantity is found only in sick and emaciated whales. Here, then, is what gives their value to the most dainty perfumes.

Though smelling disagreeably when first taken from the whale, ambergris soon gives out a fragrance which steadily improves with age. It is not for its own scent, however, that it is valued, but for its power of fixing the lighter flower perfumes, with which it

tones. As a basis for the choicest scents of this kind it has no substitute, nor have all the efforts of chemists been able to reproduce it synthetically.

It is not easy to speak definitely of the value of ambergris, which is sold by bargaining, for it comes into the market by chance, and varies greatly in quality. In the past, over £10,000 has been paid for one lump and, in small picked lots, it has literally fetched its weight in gold; but £3-£4 per oz. would probably be thought a high price at the moment. A recent consignment of 40 lbs. weight from the Azores was valued, unsold, at £1,000 in money.

There is little concerning ambergris to be found in print, for little is known. Of the size of pieces, an encyclopædia will say cautiously that they reach a weight of 100 lbs. or more. That is hardly adequate. A chief authority, Mr. A. C. Stirling, states that a lump of over 336 lbs. came on the London market in 1913. There is a record of a piece of 400 lbs., found at St. Helena in 1716; and the *Boston Ledger* for 1859 reports the taking of a lump weighing 750 lbs.

Books again tell us, in general terms, that the sperm whale lives in tropical and semi-tropical waters. It certainly does, but it ranges from 40 deg. N. to 50 deg. S., and, when it suits it, will pass round the Horn. Consequently ambergris may be found anywhere. A French expert, M. Victor Hasslauer, declares that the kind of food eaten by the whale influences the appearance, quality and smell of ambergris, so that it is nearly always possible for him, merely by handling it, to name the part of the world where it was found. He considers that the rare ambergris that is found on beaches is the best. Certainly,



[From an exhibit at the British Museum (Natural History), by permission.]

A typical cuttle fish, a favourite food of the sperm whale, possessing a beak which is shown opposite.

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the trade thinks so, and certainly, also, this bleached ambergris looks the most attractive; but it seems strange that, after several years of washing about and scorching in the sun, it should be better than the fresh product. One London expert, at least, declares that he prefers ambergris with the animal note in it. However, whatever may be the value of these white samples, there is no question that the grey product is superior to the black. This last, even if its colour is due only to cuttlefish ink, is usually mixed with blood and refuse, which gives it a strong, unpleasant smell.

Very seldom is a dead sperm whale washed ashore for, though the carcase distends and floats for a few days, its imprisoned gases soon burst it, whereupon it sinks. There is one case, however, where a whaling captain of Provincetown, U.S.A., stopped at one of the West Indian Islands, where a native offered him five small lumps of a dirty-looking substance, declaring that it was valuable—though he was not clear as to why it should be. He explained that he had got the lumps from a dead whale, which was ashore on a certain beach, and that there were plenty more in the carcase.

One would have thought that that would have been enough for a whaling captain, but not a bit of it. He gave the native a pair of overalls and a jumper in exchange for the lumps, and went on with his hunt for sperm oil. On reaching port he got a shock when a buyer gave him \$700 for the lumps. He got a worse shock when he was told that another ship captain, who had heard of the dead whale, had made for it immediately, and had sold the ambergris in it for \$30,000!

Only an expert will buy one of the big lumps of ambergris, which are sold uncut. The most valuable part of these is the core, the size of which varies and is not necessarily in proportion to that of the lump itself. Such samples may have pockets or layers of inferior or useless matter and, in their middle, there is sure to be moisture that must be allowed for. There is no acknowledged chemical test of ambergris but, if it is shaved into cold alcohol, any experienced perfumer will recognise its characteristic odour, which has been described as "musky," and also as suggestive of freshly turned earth. Ambergris melts below the boiling point of water and, at higher temperatures, volatilises in a white vapour. Its preparation is simple. It is ground, put in alcohol, and left to soak for six months or more, and then the tincture, after being filtered, is ready for use.

The source of supply of ambergris is perhaps as great as ever it was, for the oceans, as a whole, are lonelier than they have been for centuries. Modern sea traffic

runs along fixed routes, but the sailing ships went wherever they could find a wind, and the old whalers made a point of combing unknown waters. The present southern whalers bring a few sperm whales into South Georgia, but it is the blue whales that they destroy.



The parrot-like beak of the cuttle-fish which is believed to set up the irritation that causes a m e r g i s formation.

Why should this queer merchandise excel all other known substances as a fixative for scent? Nobody has the least idea. Of the animal extracts, one of which is necessary in all high-grade perfumes, ambergris has the least animal character.

Mr. R. C. Murphy, of the American Museum, advances the heretical belief that ambergris does not make an associated blossom odour more permanent, but merely prolongs its note and, itself surviving, tricks the nose of the perfume-user into believing that the original blended scent has remained unchanged. It may be that the ambergris both fixes another scent and maintains its own. If a scent-user could fail to detect the loss of part of a combined scent, an expert perfumer is not likely to do so. Ambergris seems able to fix anything. In its form of jetsam, if it cannot pick up anything else on its travels, it will give out the very tang of an ocean beach. A recent consignment lay on the drug floor of the Port of London Authority, which room was pervaded by a sweet "oriental" smell from goods from the East and West Indies. When the ambergris was unpacked, and a piece of it was smelt, it exactly reproduced this general scent, for the uncanny stuff was already at work, and taking up the aroma of the bales around it.

As regards its own scent, some tincture put on absorbent paper will last for months, becoming sweeter the longer it remains. A writer on perfumes states that it is perceptible in a room at Hampton Court Palace, where it is said to have lingered for over a century; and he asserts that it has been known to last for 300 years.

But what is the origin of this haunting sweetness? Herman Melville, in his "Moby Dick," writes, "I say, that the motion of a sperm whale's flukes above water dispenses a perfumes, as when a musk-scented lady rustles her dress in a warm parlour." But we must go further than that. The sperm whale's chief food, the mollusca, have a musky odour; and the Romans used an octopod, *Elodone moschata*, as the basis of some of their perfumes.

Whoever would master the secret of ambergris must study the *Cephalopoda*. Only so can he hope to replace the one substance which is thought fit to blend with the most delicate scents of flowers.

The Neurometer

By Frank W. Britton, D.Sc.

Bletchley Grammar School, Bucks.

Accurate electrical measurements of pupils' intellectual efforts in school seem not far from an impossibility; but Dr. Britton claims that such measurement can be made with a comparatively simple circuit. Tests carried out were in close agreement with the "marks" awarded.

A SENSITIVE galvanometer is capable of measuring the electric energy generated by two electrodes of a certain surface area upon the skin, while, provided that the total surface area of the body is known, it is easy to calculate the total surface energy on that body. The total surface area of the body is determined by means of height and weight charts so that, if we arrange two potentiometers (one representing the weight and the other height) in shunt across the meter, the terminals of which are attached to two electrodes of known surface area, grasped in the hands, the energy may be so integrated that a direct reading in terms of milliamperes per total surface area can be obtained.

Measurement of Surface Energy.

Potentiometers of approximately 20,000 ohms resistance are a suitable value, divided into graduations representing a height range from two feet to seven feet and from two to twenty stones respectively. When the contact arm of these potentiometers is moved round to the appropriate weight and height, resistance is cut out of the shunt circuit and the meter then reads to the corrected milliamperage of the total body surface-area. So much for the actual measurement of surface energy; we will now discuss the condensation current induced when the nervous system receives stimuli in the form of "shocks."

A simple spherical electrode is connected with the grid circuit of a valve oscillator, the high tension of which is fed through the galvanometer—the P.D. of this is very low, being about ten volts (it varies with both the valve used and the galvanometer), and the filament voltage two. On grasping this electrode in the hand, the capacity of the body to earth gives a definite meter reading which fluctuates according to the slightest variation in this capacity. These currents are of necessity too small to enable satisfactory recordings to be taken, so the arrangement shown in Fig. 2 is used; it is after the style of the Geiger counter for measuring the radiation from growing cells. From this circuit it will be seen that although the second electrode of the neon tube is maintained at a constant voltage it varies with the rapidity of the glow discharge from the first electrode. This trigger action releases a greater charge than the

condenser can pass, so that the counter is energised and a record made of the variations in the grid control circuit of the valve.

The two electrodes attached to the valve in Fig. 2 are of a flat plate form so that if applied to the head or, in fact, to any part of the body, they deliver a fairly uniform current-wave which is broken if the nervous system receives any form of stimulation. Such stimuli are thus recorded by means of the Geiger counter. It is interesting to observe the effect of mental fatigue—for this appears to cause an erratic and broken recording.

Tests in school with the neurometer showed that those boys who worked hardest at a set task in class expended the most energy and manifested greatest fatigue. Ten boys in a class taking a lesson in French were awarded marks for "application" by the French master, having previously been tested on the instrument. After an hour and a half a second reading was taken and the two

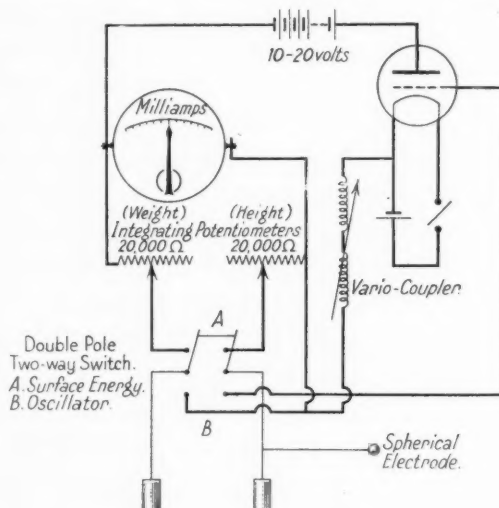


Fig. 1.—A simple neurometer circuit

compared—showing that those who had worked with greatest enthusiasm and labour indicated the greatest fatigue—the close correspondence between the two methods of assessment (by marking and meter) provided

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some useful guidance for the teacher and, in this instance, certainly indicated the latter's close attention to the individual effort of his pupils.

If readings are further taken after a set task, the approach to the normal appears in the form of a wave. Readings may conveniently be taken at half-minute intervals, thus giving an interesting record after, say half-an-hour. Applied to pathological cases, perhaps some useful graphic representations might be obtained showing the manner in which the patient's nervous system is reacting to a given stimulus. Similar apparatus designed by a Cambridge scientist is being applied in hospital tests. It will be evident that a considerable amount of research (and investigation into records and data) is necessary before these facts are pieced together into some coherent and useful knowledge, but biological

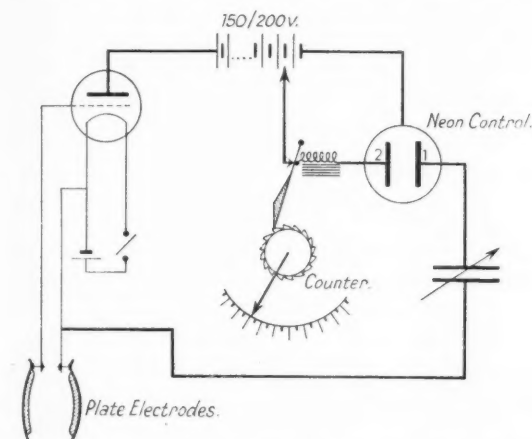


Fig. 2. A condensation electrometer, with Neon counter trigger control.

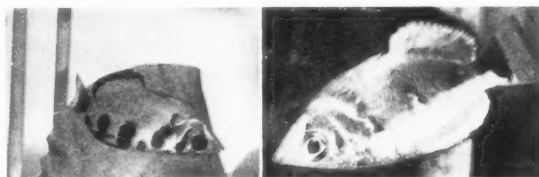
research to-day is proceeding at such a pace that many phenomena of life which would have been classified as "mysteries" a few years ago are now quite commonplace.

D. F. Fraser-Harris.

We regret to announce the death last month, in his seventieth year, of Professor D. F. Fraser-Harris, whose name had become familiar to readers of DISCOVERY from the articles of which he had published several in our columns recently. Dr. Fraser-Harris was primarily a physiologist, and physiology was always his chief study; but he was deeply versed in many branches of science, and this, together with his skill in expressing himself in language easily understood by the layman, made him an especially welcome contributor to our pages. Readers of DISCOVERY will miss the quiet humour with which he would show up, though always in a kindly spirit, the errors of those scientists whose enthusiasm led them beyond the bounds of accuracy.

Shooting Fish.

OF the various kinds of "shooting fish" from the rivers and estuaries of India, North Australia and New Zealand, which secure their prey literally by shooting at it, the best known of all is the Siamese



The Siamese shooting fish, *Toxotes jaculator*.

Shooting Fish (*Toxotes jaculator*), seldom imported alive. The fish grows to a hand's length; being a typical surface fish it has its head and dorsal section flattened out. Its ventral and anal fins are moved far back towards the tail fin. The covering of scales extends partly over the vertical fins, and the coloration of the skin is green-grey on the underside of the body growing silvery towards the top. Four irregular dark-tinted cross-bars are drawn downwards from the dorsal part, but they do not extend over the whole of the body. The pointed irregular head shows a large and vivid eye and a widely-split slanting mouth, the lower jaw of which projects considerably over the upper.

When swimming near the surface, the fish, which has the sense of sight developed to a high degree, looks for plants above the water level. As soon as it has caught sight of an insect within range it approaches the unsuspecting prey cautiously, and then suddenly, with great precision and speed, it shoots a drop of water at the victim. The insect struck by this unexpected shot falls into the water and is immediately swallowed by the skilful hunter. With incredible speed, and with the mouth closed, the fish ejaculates through a hole on top of its mouth by suddenly contracting the muscles specially developed for this purpose. Occasionally the fish does not shoot, but will reach any insect close to the surface by jumping up at it.

These fish are very seldom secured by the ordinary aquarium owner, since, being natives of tropical waters, they have to be kept in a heated tank. After a short period of training, the fish become tame and take food from the hands of their keepers. They may be fed with little pieces of meat and fish and with water-fleas. They never pick up their food from the floor, owing to the slanting position of their mouth.

Sometimes with shooting fish that have been tamed if the keeper incautiously bends over the basin he feels himself shot by a drop of water, often from as great a distance as eighteen inches.

Iodine-Silver Detection of Finger Prints.

By John McMorris, Ph.D.,

Pasadena Junior College and Pasadena Police Department.

The writer of this article describes a method whereby latent finger prints, which do not give good results with the usual powder method, may be developed and copied.

A SURVEY of the commonly practised methods for developing finger prints shows each to have certain distinct individual defects along with the good qualities. Finger-print powder, for example, may stick stubbornly to the neutral surface, hiding the latent image. It rapidly loses its value when the latent image, through age, begins to lose its "tackiness" to powder. The silver nitrate method, on the other hand, is technically difficult to apply and would seem, from its general character, to be applicable to very few types of surfaces. The third well-known method is the iodine one. Although easy to apply to some surfaces, this method frequently yields images too transient to be clearly visible more than a second or so. In addition, the brown images obtained often lack sufficient contrast for any practical application.

Iodine a Useful Reagent

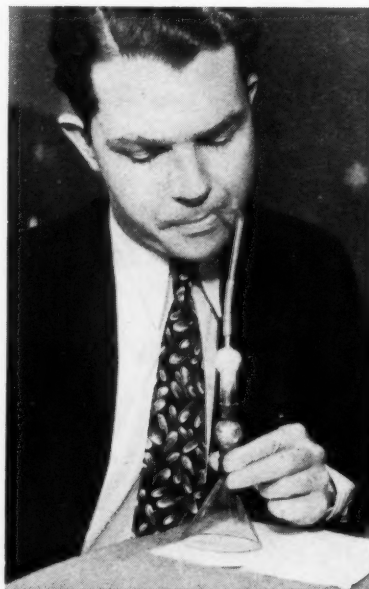
Improvement in any given method can be most easily brought about if the defects are recognised and removed. From a chemical viewpoint, the iodine method would seem to be the one most easily susceptible to improvement, for iodine is a chemical which reacts vigorously with a very large number of other substances. Thus, new reagents might conceivably be found which would improve the stability of the image and at the same time greatly increase contrast. On experimenting in this direction, the promising new technique described here was discovered. This makes use, as a first step, of the conventional iodine method, slightly modified. After the latent image has been fumed with iodine vapour, a sheet of silver is pressed against it. The silver sheet is then removed and exposed to direct sunlight or photo-flood light, a strong black image of the latent image shortly appearing on the silver. In attempting to develop a practical process, each step has been examined for a simple and trustworthy procedure. The directions here given are merely comments upon the method as I now practise it, and may, of course, not represent the best possible mode of execution.

Since most objects which could bear latent finger prints are too bulky for enclosure in a container containing iodine vapour, a simple instrument was devised for fuming *in situ*. The instrument may be simply a length of half-inch glass tubing, say four inches long, constricted at one end for a rubber tubing connection.

A straight calcium chloride tube bought from any chemical supply house will fill the requirements. Stuff a pad of glass wool as far as it will go into the large opening, pour into the tube a half-teaspoonful or more of iodine crystals and then push in another pad of glass wool so as to enclose the crystals safely in the tube. The breath can be blown through the tube carrying iodine fumes out at the large opening, the iodine being warmed with the hand if more vapour is desired.

The fuming operation with this instrument is extremely simple. The large opening is swept over the surface under examination, very much in the style of a painter spraying a surface with lacquer. Holding the instrument a distance of about half-an-inch from the surface will give good fume density and also good coverage. In actual tests, both sides of a sheet of 8½ by 11-inch paper were completely "prospected" for prints in less than one minute. When a latent print is discovered, the area can receive a more liberal fuming to yield the maximum contrast. The amount of time required for fuming a single latent image is variable, ranging from a second to almost a minute. Prolonged

fuming is seldom advantageous except with very old "latents." In fuming glass and metallic objects the use of this simple instrument may result in a mist condensing on the surface from the moisture in the breath. To prevent this, simply pour a teaspoonful or two of anhydrous calcium chloride into the tube before introducing the



Fuming latent prints with breath dried and passed over iodine crystals.

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iodine crystals. The calcium chloride and the iodine should be separated by glass wool. In this way dried air is forced through the iodine crystals and, consequently, no condensation of moisture on the latent image can take place.

The silver surface upon which the transfer is to be made must be prepared with care. Any thickness of sheet can be used, but thin sheet should be very smooth

and free from scratches, but not mirror-polished. A suggested technique is to pickle mirror-polished silver sheet in sulphuric acid to produce a silver-grey matt surface.

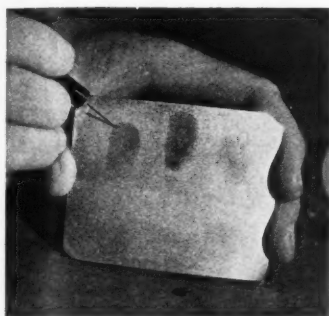
Depending upon the amount of iodine which has been taken up by the latent print, the correct time of con-

tact of the silver with the surface may extend from one second to perhaps ten. Usually a faint brown image on the silver may be seen when the sheet is lifted. When the sun is shining, the image on the silver is very simply developed by exposure to direct sunlight for a half-minute or so. More extended exposure to strong

light will help to give density to weak images. A photo-flood bulb gives an intensity of the same order at close range so the light source is no problem. Ordinary electric bulbs are too weak to be useful.

If the method has worked satisfactorily, there will be at this stage a strong black print of the latent image on the silver surface. If, however, the print is too strong or too weak the process may be repeated, making such corrections as seem necessary. In my own experience, five transfers have been made from a single latent image, the fifth transfer being just as good as the first. Moreover, the application of this method does not result in the destruction of the latent; so far as I can determine, the powdering qualities are left intact. If desired, the silver sheets may be entirely permanent. In those cases in which photographic copies of these silver images are desired, the copies may be made by using regular process film. To remove the image from a silver sheet, simply polish carefully with moist whiting or, better still, optician's rouge.

The new method has been applied to many types of surface with success. Some of these same surfaces would be very ticklish problems with existing methods. As an example, practically perfect images have been obtained from waxed and polished furniture and from greasy enamelled kitchen stoves. Both of these types of objects commonly yield very bad results with powder. Good prints have, under favourable conditions, been obtained even from cotton and silk cloth.



Prints of three fingers on the silver plate.

Origin of Speech.

Study of fifty brains of primates, ranging from the lemur to man, in the primate brain collection of the Smithsonian Institute of Washington, D.C., which thanks to Dr. A. Hrdlicka is probably the largest in the world, has led Dr. C. Connolly of the Catholic University of America to some interesting conclusions bearing on the origin of speech. He finds that the region of the brain cortex known as Broca's area, which is held by neurologists to control the function of speech, is absent in the gibbon, but first appears in rudimentary form in the orang-utan. It is present also, but more emphatically marked, in the chimpanzee and gorilla. Further, a V-shaped region in Broca's area, possibly to be associated specifically with speech, is found in man alone, though there is evidence of this region in *Pithecanthropus* and Neanderthal man, the precursors of "modern" man. This may be interpreted to mean that while the potentiality of speech is present in three of the great apes, the brain does not attain that degree of specialisation which makes it possible for articulate speech to become an actuality before the stage of evolution of *Homo sapiens*.

Books Received.

- The Bornu Sahara and Sudan.* By SIR RICHMOND PALME. (Murray. 42s.)
- Adam's Ancestors.* By L. S. B. LEAKEY. (Methuen. 7s. 6d.)
- Naven.* By GREGORY BATESON. (Cambridge Univ. Press. 18s.)
- The Preservation of our Scenery.* By VAUGHAN CORNISH. (Cambridge Univ. Press. 7s. 6d.)
- The Archaeology of Sussex.* By E. CECIL CURWEN. (Methuen. 12s. 6d.)
- Revisiting my Pigmy Hosts.* By PAUL SCHEBESTA; translated by G. GRIFFIN. (Hutchinson. 18s.)
- Gone Nomad.* By ARCHER RUSSELL. (Angus & Robertson. 7s. 6d.)
- Matthew Boulton.* By H. W. DICKINSON. (Cambridge Univ. Press. 10s. 6d.)
- Green Laurels: the Lives and Achievements of the Great Naturalists.* By D. C. PEATTIE. (Harrap. 12s. 6d.)
- A Manual of Radiological Diagnosis.* By I. C. C. TCHAPEROFF. (Hefner. 21s.)
- An Introduction to Comparative Biochemistry.* By ERNEST BALDWIN. (Cambridge Univ. Press. 5s.)
- Bull-Roarers in the Papuan Gulf.* By F. E. WILLIAMS. (Papua Govt. Press, Port Moresby.)

The March of Knowledge.

Safer Flying Tests of an invention which should make a great contribution to the safety of flying, especially on the approach for landing, have lately been completed on model wings in a small wind-tunnel. The invention, which is now awaiting full-scale development, consists of a device for opening out a slot in the after-part of the wing some distance from the trailing edge the moment the flap is depressed. The effect is to create a circulation about the after part of the wing, which is the part most likely to stall first at either very large or very small angles of upward tilt.

Wanderer's Return After a silence of seven months, an exploration party led by Mr. Ivan Champion, an assistant magistrate in the Papuan service, has returned to Port Romilly. The party ascended the Leonard Murray Mountain, went across the Patu and Upper Kikori to Lake Kikubu, then north-east across the valleys, over Mount Giluwer, and down the Kuical valley to the Purari. Friendly relations were established with all tribes. No lives were lost and there were no hostilities.

Protecting Shipping With approximately 50,000 miles of coast line along the Atlantic and Pacific Oceans, the Great Lakes and other lakes within the boundaries of the Dominion, the Canadian Government Department of Marine has to maintain an extensive lighthouse service. This service requires, during the season of navigation, 2,000 lights, 400 fog signals, 600 gas and signal buoys, 12 lightships, 32 radio stations, 9,000 unlighted buoys, beacons and day marks, a total of more than 12,000 individual establishments. One of the best known lighthouses under the administration of the Department is the lighthouse at Cape Race, on the coast of Newfoundland. The flashing light in this lighthouse is over one million candle power and has been seen a distance of 76 miles. The optical apparatus and lantern weigh 42 tons and cost \$40,000.

Soda Lake A new exhibit presented by the Magadi Soda Lake Co. to the East African Court at the Imperial Institute, South Kensington, illustrates by maps, diagrams, charts, photographs and specimens the exploitation of one of the most remarkable natural soda lakes of the world. Though 39,000 tons of soda products were exported from Lake Magadi last year to Japan, India and Australia, the supply is not being depleted, for the thermal springs which feed the lake are bringing in fresh supplies of soda faster than the company is removing it. During the dry season evaporation produces a crust of natural

soda, so that for the greater part of the year the surface of the lake is a dazzling white mass of crystals.

Substitute for Pumice The demand for lightweight concrete in modern building is increasing, and several novel materials which can be used for making it, in place of pumice mainly imported from the volcanic deposits near Coblenz in Germany, or furnace clinker and coke breeze, are described in a bulletin prepared by the Building Research Station. One of these products, new to this country, is "foamed slag" made by rapidly chilling molten slag from blast furnaces manufacturing pig iron. Foamed slag is extensively used in Germany and competes seriously with pumice even in the vicinity of the pumice quarries. Building blocks are made of various sizes and shapes so that it is not necessary to cut blocks during construction. It is claimed in Germany that blocks 50 per cent. larger in size than ordinary clay bricks are only half the weight, and for the same volume are only half the price of clay bricks. An example in this country of the use of foamed slag concrete blocks is to be found in the Fire Testing Station at Elstree, Hertfordshire, recently erected for the Fire Offices Committee. Production has also been begun in this country of a light material obtained by rapidly heating clays and shales.

26,000 Specimens Miss L. E. Cheesman has returned to England after a year's absence on a collecting expedition to Dutch New Guinea, to carry out research into the insect fauna of the Cyclops Mountains. The mountains, 30 miles long, are a very old range of pre-Cambrian continental rock, crystalline schists and gneisses, on the N.E. coast of Dutch New Guinea, near the border of the Mandated Territory. The collection consists of about 26,000 specimens and includes insects, 500 reptiles, 300 fish, mammals, spiders, scorpions, molluscs, centipedes, earthworms and parasitic worms, and ferns.

New Metal Works With the object of exploiting Norwegian molybdenum deposits, the Ugelstad Molybdengruber A.S. has been formed at Drammen. Preliminary work will start this month and the annual output capacity to begin with will be about 120 tons of molybdenum. An iron-tantalum-niobium alloy is to be produced in Belgium by the Geomines Tin Mining Co. This company does its own smelting and can make the alloy in its electro-furnaces. The Belgian iron industry will provide a market for the alloy.

A New Holbein One of the earliest works of Hans Holbein the elder dating from 1493 has been discovered in the parish church in the Bavarian villate of Hindelang, near Lake Constance. The painting represents the Madonna and Child.

FROM recently Galago became of the German occur o

This species, in fact, ively sn m a l. Galago feet lon than h length taken up long and tail. Th animal an a m compa The larg eyes an enormou ned ear plainly the Gal night - In their surrou the wake u in the high abo cularly endowed

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The Galago.

By Dr. H. Schmidt-Schaumburg.

FROM Mozambique, in Portuguese East Africa, I recently received an interesting animal, a Giant Galago (*Galago crassicaudatus*), which, after a time, became quite tame. The Galagos belong to the order of the lemurs and are sometimes called *Orenmakis* in German on account of their long, bat-like ears. They occur only in Africa and the neighbouring islands.

This Galago is the largest of a number of related species, but is, in fact, a relatively small animal. My Galago was two feet long, more than half his length being taken up by the long and bushy tail. This small animal proved an amusing companion.

The large round eyes and the enormous skinned ears show plainly that the Galago is a night-animal. In their native surroundings the Galagos wake up late in the day, and then start their ghostly activity high above in the crowns of the trees. They are particularly well equipped for this night life, and are endowed with very acute senses.

Their activity is noiseless and stealthy; in the branching tops of the trees they eat all the small animals they meet with. It matters little whether their food consists of insects, birds or reptiles, and they by no means refuse eggs or fruit. While in captivity they get accustomed to a more vegetarian diet. My Galago ate all kinds of insects, lizards, small birds, and raw meat; he liked fruit very much, especially bananas and dates, but also any scraps from the table. His favourite drink was milk.

He did not always remain quiet. At times he took enormous jumps from one tree to another like a squirrel, using his long and bushy tail as a rudder.

If I wanted to catch him, and he did not wish to be caught, his jumping feats were considerable. When I chased him on the ground he would jump away, upright on his hind legs, with his tail bristling, like a little kangaroo. When he was piqued and did not want to be touched, he threw himself down on the floor and snarled. But, on the whole, he was very affectionate. He climbed over my outstretched arm up to my shoulder, and then gently scratched my hair and ears, cooing like a dove. Those were the only utterances I ever heard from him.

His light-fingered hands, broadened out like those of the frog, enabled him to climb even among the thinnest branches. All his fingers had real nails, except the first which bore a claw, frequently used to comb his long and dense silver-grey fur. The way the Galago sleeps is very peculiar. He folds up his large ears, closing them to every sound, puts his face in his hands, rolls himself up and uses his tail as a cover.

Animals of this group are, as a general rule, twilight, not nocturnal, beasts, for my Galago used to sleep regularly for a few hours about mid-time. After a time, when they are tamed,

they take to a daylight life, but contrary to the general opinion, they are able to see in the daytime quite as well as during the night. The Galagos, in their native country, are called bush-babies because they cry very loudly, like children. According to Brehm the word Galago is derived from a name given to the Senegalese inhabitants of Africa.

The 250-page catalogue of Watson Microscopes and Accessories, just published, will interest all those whose work involves the use of exact magnifying instruments. This catalogue embraces only parts 1 and 2, but over one hundred models are described and illustrated.

The Forest Tour, organised by the Booth Line, by which travellers may journey 1,000 miles up the Amazon in a comfortable steamer, still remains one of the best methods of visiting South America. The *S.S. Hilary* makes the first trip in 1937, starting on February 6th, and followed by the *S.S. Anselm* on February 26th.



The Galago in playful mood (above), and below, stretching out for its food with a very childlike gesture.



Book Reviews

Zenith of the Roman Empire

The Cambridge Ancient History. Edited by S. A. COOK, F. E. ADCOCK and M. P. CHARLESWORTH. Vol. XI, The Imperial Peace, A.D. 70-192. (Cambridge University Press. 35s.)

The Roman Empire at its zenith is the theme of the last volume but one of the great Cambridge Ancient History—the best of all these co-operative undertakings. The period from Vespasian to Commodus, when Rome's rule extended from Scotland to Mesopotamia, seems on the whole the most peaceful and prosperous era that the ancient world ever knew. Even now, wide regions that supported thriving populations under the Empire lie waste and have yet to be reclaimed for civilisation, as in Arabia or Asiatic Turkey. In this massive volume of a thousand pages that covers every aspect of a vast subject, the sections that deserve special mention are those dealing with the outer fringes of the Empire, most of them by foreign scholars. Thus Professor Ekholm of Uppsala gives an illuminating account of the peoples of Northern Europe and incidentally says that the statements of Tacitus in his *Germania* are largely confirmed by archaeological research. Professor Alföldé of Budapest deals with the Scythians and Dacians, and Professor Rostovtzeff with the Parthians, whom the Romans fought with varying success in many campaigns but never subdued. Dr. Franz Cumont describes the high prosperity of Syria and Western Arabia under Roman rule; his account of the splendour of the many Syrian towns, with Antioch at their head, and of the great trade across the desert from Palmyra to the Persian Gulf reminds us all too forcibly of the completeness with which the Arabs and Turks wiped out this civilisation, that is now at last beginning to be restored. Professor Romanelli's chapter on Cyrenaica is equally impressive; in that province, however, a frenzied Jewish revolt against Trajan began the decline long before the Arabs' invasion. The story of the Roman provinces is, indeed, full of meaning to the optimists who think that progress is continuous and that highly civilised societies need not fear the barbarian. The countless ruined cities of Western Asia and Northern Africa tell a very different tale.

Within the Empire good roads made for easy travel and Latin and Greek were everywhere spoken and understood. Thus Christianity was able to spread rapidly from Palestine to Rome and the provinces. Once again the Cambridge Ancient History will delight the student with its numerous excellent maps and its

bibliographies. One volume more will bring the history up to Diocletian and the end of a very great enterprise. E. G. HAWKE.

The Water Supply of England

The Nation's Water Supply. By R. C. S. WALTERS. (Ivor Nicholson and Watson. £1 11s. 6d.)

The droughts of 1933 and 1934 apparently suggested to Mr. Ivor Nicholson that it would be opportune to publish a book addressed to the intelligent general reader on the major problems of Great Britain's water supplies. Accordingly he invited Mr. Walters, a leading water engineer, to write such a book; and in the hope of rendering a valuable public service, Mr. Walters readily accepted the invitation. The finished volume bears eloquent witness to the diligence of Mr. Walters' performance; and yet, for all the care that so clearly has been bestowed upon it, something fundamental seems to be lacking in the essential character of the book. Perhaps Mr. Nicholson too soon lost interest in the subject of water shortages and supplies; perhaps he failed to appreciate that Mr. Walters might prove less expert as an economist and author than he is as an engineer; or perhaps he placed too much reliance upon the supervision of some poorly qualified member of his editorial staff. Be the reason what it may, the fact remains that he almost entirely ignores the central economic questions of demand and supply—how much water does the ordinary British consumer require, and at what cost can that water be supplied?

What Mr. Walters has chiefly done is to write a general account of the physical characteristics of the principal water supplies of England, Wales, and Southern Scotland; and this he presents under the three main headings of the upland, the underground, and the river resources. These three topics constitute the three principal chapters of the book, chapters in which almost every page presents some point of novelty and interest. But the chapter on "Legislation and Water-supply," the question of greatest general concern, is brief and vague. It refers casually to the possibility of a future general Water Act, without making any estimation of the prospects of framing and passing such a measure; and after discussing, in only four pages, the problems of rural supply and of droughts as the two special problems of to-day, it disposes of them abruptly by saying, "they are not so much problems of resources, but problems of finance." For the general reader, a most inconclusive conclusion. C. P. WRIGHT.

An Examination of Logical Positivism. By JULIUS RUDOLF WEINBERG. (Kegan Paul. 12s. 6d.)

Logical Positivism, the philosophy of the "Viennese Circle" founded in 1928 by Professor Schlick *et al.*, proposes "to provide a secure foundation for the sciences, and to demonstrate the meaninglessness of all metaphysics." Sired by Wittgenstein's "Tractatus Logico-Philosophicus" out of Russell and Whitehead's "Principia Mathematica" it descends from Mach, Avenarius, Comte, Kant, Hume, and Leibniz. Its fundamental doctrines are: 1. that propositions of existential import have an exclusively empirical reference; 2. that this empirical reference can be conclusively shown by logical analysis. By logic the Viennese Circle understands the Russellian "calculus of propositions," or a set of formulas which assert nothing about meaning but simply show how propositions are connected by means of a system of mathematical notation which, incidentally, is not nearly as difficult as it looks. Professor Weinberg's exposé is not encouraging. He finds that Logical Positivism tries to solve the problem of induction (briefly, that of validating inferences "from these to all" and "from these to any") by declaring that there is no such problem. Logical positivism denies that induction seeks to establish general propositions; its function is merely to predict and verify singular propositions framed according to "models" which benighted thinkers of other schools presume to call laws and to endow with prescriptive validity. Why we should trust induction as a basis of expectation, proportionately to the number of positive instances, remains, as Dr. Weinberg justly points out, a mystery. This method of solving difficulties by ignoring them seems to be in favour with Logical Positivists. They abolish metaphysics by declaring metaphysics non-empirical (which is a well-known tautology) and by adding that all non-empirical propositions are nonsense (which is simply and obviously not true). The principles used to demonstrate that metaphysics are nonsense land Logical Positivism in a bad mess: first, these very principles lead to metaphysical (empirically unverifiable) assertions; second, they "render much of science nonsense by implying a solipsism of language," *i.e.*, the impossibility of translating my experiences into terms of yours.

The scrupulous fairness of Dr. Weinberg's examination is vouchsafed by our discovery halfway through the book that he does not plead the cause of Logical Positivism but judges it. But doesn't he take too much trouble? What it all amounts to is that Logical Positivism pretends to demonstrate principles which it takes for granted at the outset. Logical Positivism is true if it can be proved; but it can only be proved in a world constructed to fulfil the requirements of Logical Positivism. We are happy to say that the world is not so constructed. In all fairness, this predicament is not peculiar to the Viennese Circle. Every philosophy embodies an ontological decision, or a set of assumptions as to what the world is like, which cannot be demonstrated by logic, since all demonstration proceeds from it. An ontological decision can only be explained psychologically; apart from that, it can be either avowed, or else concealed. Hence all attempts to date to prove that metaphysics are impossible have been unmasked as a form of self-deception couched in metaphysical language. The teaching of Logical Positivism may be reduced to the statement, "If something is, something is." That is no novelty; it was dealt with adequately when it was first proposed by Nicolas d'Autrecourt some seven hundred years ago. It is a pity that Dr. Weinberg should spoil his effect by proposing amendments of Logical Positivism which to a mere realist sound like asserting that the moon is not made of green cheese, since it is made of bluegreen cheese. It is all full of sound

and fury, signifying very little beyond the old-fashioned desire to make the world understandable by the simple expedient of ignoring Aristotle.

EUGENE BAGGER.

Songs of Wild Birds. By E. M. NICHOLSON and L. KOCH. With gramophone records. (Witherby. 15s.)

This book owes its origin to the gramophone records of bird-songs obtained by Mr. Ludwig Koch in collaboration with the Parlophone Co. As Dr. Julian Huxley says in his introduction, it contains the best records of bird-song yet made; and also, in Mr. Nicholson's chapters, the most stimulating discussion of bird-song written in recent years. It is the first-sound-book published in Britain. Mr. Koch describes how, during last spring, he toured the country in a Parlophone travelling van containing a complete recording studio and apparatus; it was necessary to lay many hundred yards of cable and often to instal five microphones; even then the birds did not always play up, or their voices were drowned by wind, rain or rush of water. It is wonderful that in spite of endless difficulties and disappointments such splendid records were obtained.

I tested the records on four different makes of gramophone; the best results were obtained from an electrical instrument. I noticed that songs of a lower pitch and frequency usually came out the most clearly. Indeed the blackbird's, thrush's, nightingale's and chaffinch's songs sound so loud that in a small room they are almost deafening. The robin's and willow-warbler's cadenzas were clear, and very sweet in tone; cuckoo, wood-pigeon, turtle-dove and great tit also came through well, but wren, common whitethroat and dunnoek were dim and distant; neither I, nor another listener with a trained musical ear, was able to distinguish the chiff-chaff. The drumming of the pied and the laughter of the green woodpecker were admirable. The most elaborate and longest record is that of the nightingale. When I tried the records in the open air they met with no response, and the tame robin that enters my study turned his back on the record of his own song, but in spring the result might have been different. Most of the book is taken up with a comprehensive survey by Mr. Nicholson of our present knowledge of bird-song. The highest development occurs in songs which include selection, contrast, and imitation.

Mr. Nicholson tentatively classifies songs, according to the degree of development they have reached, under four categories: I. Highly developed songs: II. Finished song-patterns: III. More primitive types of song: IV. Breeding notes and song substitutes. In the first he places ten species: woodlark, skylark, marsh-warbler, sedge-warbler, garden-warbler, blackcap, thrush, blackbird, nightingale and robin. In the second class he includes the buntings, pipits, and the rest of the warblers, except reed-warbler: the third he sub-divides into three sections which contain (*inter alia*) starling, goldfinch, linnet and reed-warbler: to the fourth he delegates tits, cuckoo, owls, doves and many others.

Accepting his criteria, there is little to criticise in this classification. But many bird-lovers consider that the highest development is found rather in sweetness and quality of tone than in selection, contrast, and imitation: considered aesthetically wood and willow warblers, tree-pit, lesser whitethroat, whinchat, linnet, goldfinch, bullfinch, turtle-dove and perhaps dipper, deserve promotion to a higher class. The short chapter on the appreciation of bird-song is one of the best things he has recently written.

It is good news that other song-records may be prepared in the future: if possible skylark and woodlark should be recorded, though this will be difficult: also garden-warbler and blackcap, whose songs it should be comparatively easy to obtain. The value of the book and the records both scientifically and educationally cannot be overestimated.

E. W. HENDY.

The Emergence of Human Culture. By C. J. WARDEN. (Macmillan. 9s. 6d.)

THIS is a useful and very suggestive book. It is eminent as a summary of general conclusions on a large range of important subjects and it is stimulating by the opposition which it arouses to the author's own views where they appear too sharply drawn or to miss some capital point on the other side. The conclusions summarised relate mainly to two great domains of recent enquiry, the general biological advance from lower animal life to human civilisation and the various stages in the human evolution itself. On each of these Professor Warden has assimilated a vast quantity of matter and presents it in a clear and well arranged form. The bibliography of works, especially on the animal side, is useful and most impressive. It certainly appears that more has been done on the subject in America than with us. The author skilfully selects in order to lead up to the human advance, and contrasts, first the intellectual and social life of insects, then of birds and lastly of mammals before approaching his proper subject of human culture. It is here that one may feel that he draws the contrast too sharply. The latter and major part of the book gives a summary of the lines and characters of human culture and is assisted by several illustrative diagrams and tables. In this part he relies more on English and other European work and is in general agreement with Sir Arthur Keith and the bulk of recent anthropological work.

The years to be allowed to the specially human process seem constantly to grow in these speculations. Professor Warden would have us give twenty million years since the appearance of a pre-human stock and a million and a half for the story of *Homo sapiens*. He fixes the habitat for the first hominoid being as central Asia, north of the Himalayan ridge the uplift of which probably led to the divergence between the pre-human and the pre-ape stems. The descent from the trees was the capital event, though we should more accurately state the sequence by saying that the trees left man rather than that man left the trees. The struggle for existence, as the trees disappeared in that northern region, was the chief efficient cause for the development of specially human powers and qualities. But on this, the most important aspect of the subject, the reader must turn to the book itself. One might say, as a general criticism, that it tends somewhat to subordinate the role of the social and integrating mind in man. If this were allowed more prominence, the author would take a somewhat less uncertain line in contemplating the future. But the book on the whole is probably the best general survey of a supremely interesting subject that is obtainable at the moment.

F. S. MARVIN.

The Rise of Modern Physics (2nd Edition). By HENRY CREW. (Baillière, Tindall & Cox. 18s.)

To deal with so enormous a subject in a book of 400 small pages is a formidable problem; and yet a book of this kind is badly needed. For better or for worse we have built up Physics

on certain foundations, and the shape of the subsequent building necessarily conforms with those foundations and cannot be understood as a whole without some knowledge of the working of the minds of the founders, and of the materials and methods they used. Professor Crew has boldly faced the problem of choosing between a presentation of the largest possible amount of material in a short book, and concentration on certain branches of physics which best serve the purpose of exhibiting not so much the discovery of a large number of facts, but the beginning of experimental method and the steady development of that method. By assigning nearly half his book to mechanics and optics he has been able to give the student an extraordinarily fascinating description of the essential character of "Physics," namely, the complex welding of searching experiments and mathematical skill and insight. Great as have been the advances in electro-magnetism in the 19th century, every student knows that its theoretical treatment grew entirely out of mechanics and optics. Electricity and magnetism naturally occupy most of the other half of the book—but the author is careful to explain that he has deliberately ignored what he distinguishes as "recent" physics, guiding the student through what he calls the "large and strong structure which has been erected on these older foundations" without taking him on the somewhat perilous scaffolding which surrounds the recent additions.

It is at first sight startling to read a history of mechanics that ignores Laplace, Lagrange, and Hamilton say, or of optics, electricity and magnetism that ignores Green, Poisson, and Heaviside; but presumably the author considered it impossible to expound the significance of their work to students of the type catered for in this book—and he is probably right. On the other hand, surely the significance of entropy is too far-reaching in the development of physics to be dealt with so summarily (the index does not mention it); and it might be suggested that the theory of elasticity was so important a bridge between mechanics and optics and electromagnetism (in the aether days) that the development of that subject is worth consideration. There might, too, have been room for mention of Lord Rayleigh and "sound," and it is a little surprising to hear nothing of the Curies and radium or of the classical experiments of Professor C. T. R. Wilson. The chapter on relativity is, it might be suggested, unnecessary in a book limited in scope on the author's principles—there are so many elementary "expositions" of relativity on the market and this chapter is not any marked improvement on them.

But the book is very readable and I know of no other work which in so short a space and in so attractive a manner introduces the student of physics to the history of his subject. It can be read by anyone, as it requires no special technical knowledge.

A. C. MENZIES.

Great Earthquakes. By CHARLES DAVISON. (Murray. 17s. 6d.)

Earthquakes. By NICHOLAS HUNTER HECK. (Oxford University Press. 16s.)

It will be news to most that there is an earthquake every few hours, and that a major one occurs about once a week, upon the average. In this country, fortunately, we seem to be relatively immune, yet we have produced some of the leading pioneers of seismology, from Mitchell (1769) to John Milne, who founded the Seismological Society of Japan. It is, perhaps, the Japanese who have suffered most, and they, with the Americans, who have since led the study of those elastic waves in the

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earth's crust which tell us more of the interior than any other evidence. They seem to tell us that the core of the earth is a liquid more rigid than steel, and confirm the view of many geologists, that the central core like so many meteorites, consists of iron with an admixture of nickel.

But the influence of earthquakes upon humanity is so appalling and has been so disastrous that the practical aspect outweighs the academic. The lesson told us by Mr. Heck (whose book was published originally by the Princeton University Press) is that the tremendous loss of life and destruction of property is largely avoidable. At Messina, for instance, although the loose alluvial subsoil was responsible for much, the loss of life, amounting to nearly 100,000 persons, was mainly due to faulty construction of buildings and inferior material. The flimsy houses of India and Japan collapse under the feeblest shocks, while in Charleston a negro family in a log cabin slept undisturbed through an earthquake which let down the city from 6 to 15 ft., because their hut happened to embody the right principles. While some pagodas and cathedrals have escaped, lofty buildings act as inverted pendulums and for the same reason chimneys are a source of danger and should be reinforced. As the damage is done in a few seconds, it is useless trying to run to safety, and the best places to spring to for refuge are doorways and the open road; the American author reminds us that sidewalks are the most dangerous spots.

Even in cities, however, much of the devastation can be avoided by proper design in building, by good bonding and proper bracing, especially in frame construction, by adequate communications and quake-proof reservoirs of water. In discussing frame buildings, Mr. Heck omits one important detail that other American writers have noted, that in infested districts, care must be taken to ensure that the timber work is termite-proof. The essential is to realise that an earthquake is not a force that can be overcome, but an inexorable motion to which everything must yield. Dr. Davison gives a detailed description of eighteen historic earthquakes, marshalling all evidence available for their study. Mr. Heck, who is Chief of the Division of Terrestrial Magnetism and Seismology in the United States, gives a kind of textbook on earthquakes, of interest both to the scientific workers and to the engineer and architect.

MALCOLM BURR.

Dedalic: a Study of Dorian Plastic Art in the 7th Century B.C.

By R. J. H. JENKINS. (Cambridge University Press. 7s. 6d.)

This small book is symptomatic of the increased research now being carried out by archaeologists on Greek archaic art of the earliest phase. The author examines a mass of material, hitherto not well classified, covering the dates 700 to shortly after 600 B.C., and establishes a group of local varieties of one general style of art. The style itself is distinguished by a very fixed type of human head and features, particularly in female statues and statuettes. It appears suddenly, following immediately after a freer but less artistic Geometric phase, when artists were individual and not standardised. Clearly the "Dedalic" style, as the author calls it, can rank as the first real stage of Greek sculpture on its rapid advance. From the "Dedalic" phase the riper Archaic art of the 6th century ultimately developed. It is important to realise that it was Crete and the Peloponnese which thus took the lead, as contrasted with Attica, which followed an equally striking but purely local style of her own. And yet it would be rash to presume that the Peloponnesian artists were in advance of Attic. They were not. Indeed the first Attic

sculpture of the 7th century is so efficient and magnificent that subsequent discovery may yet reveal for us an earlier and parallel Attic development. The author has established a typology of his "Dedalic" statues and small works of art which, like all typologies, is to some extent arbitrary. For the great difficulty with 7th century Greek plastic art is that there are no absolute and wholly ineluctable dating points. The chronology will thus have to be provisional. It is derived in the main from already existing chronologies for pottery and from the better fixed datings of the early 6th century. But these too are provisional.

The author rightly calls attention to the beauty and skill of the Louvre "Auxerre" statue and notes the unusual character of the Prinias temple figures in Crete. The latter he fails to fit in to his system. Students of Greek art will find in his plates a very attractive series of heads of one firm type, largely influenced by Egyptian and other oriental elements in essentials, but essentially Greek in feeling.

STANLEY CASSON.

British Grasshoppers and their Allies: a Stimulus to their Study.

By MALCOLM BURR. (Philip Allan. 6s.)

The object of this little book is "to stimulate interest, to induce collectors to pay attention to a group of insects that has been undeservedly neglected in this country." It is well written and there is no doubt that it will fulfil its purpose. The grasshoppers, earwigs and cockroaches are, indeed, much neglected in this country, probably owing to the small number of species that occur in the British Isles. Dr. Burr enumerates only 36 (including one mentioned in an appendix), whilst about 75 are known from Germany, and over 200 from France with her favoured Mediterranean coast. However, the reduced British fauna offers a number of interesting geographical and ecological problems. Though the book is purposely written in such a way that every reader who is interested in entomological matters is able to understand it, it also contains valuable scientific information, particularly in the distributional maps. Chapters on classification, variation (size of wings, colour-patterns), stridulation, fossil orthoptera, and collecting, precede the systematic part. The latter is quite up to date; it also contains hints as to which species might still be discovered in Great Britain, and where they could occur. There are very few inaccuracies in the book. They are unimportant, and the only one worth mentioning is that *Podisma frigida*, a polar and alpine species which might one day be found in Scotland, is blackish brown, and not green. It is regrettable that, for reasons of space, Dr. Burr has decided to give as few references to other publications as possible. A bibliography would have been a help to those who, inspired by his little book, undertake to step in and specialise in this group of insects which, perhaps, offers more opportunity for "discoveries" at home than any other.

F. E. ZEUNER.

Audubon. By CONSTANCE ROURKE. (Harrap. 12s. 6d.)

"Audubon has been pictured as a mild dreamer," writes Miss Rourke, "idling his hours away in the forest, seeing the beauties of nature in a rosy mist." This biography is proof to the contrary. The story of his ornithological expeditions, which extended from Florida to Labrador, reveal him as a man of superhuman activity. His birth and origin are still a mystery: probably his real name was not Audubon. Failure in business did not daunt him; though at times penniless, he never faltered

in his resolve to publish his famous *Birds of America*. To obtain money for his researches he painted portraits, gave lessons in dancing, music, drawing, and French, and his devoted wife took situations as governess.

It was in England that he first obtained recognition. Christopher North backed him in Blackwood's and honours were showered upon him, but it took him twelve years to get his great work published: his first engraver threw up the contract; when eventually it was completed he made no money out of it, though Cuvier called it "le plus magnifique monument que l'art ait encore élevé à la nature." Miss Rourke compares him with "the men of the Middle Ages who were . . . skilled in the handicrafts as well as the arts . . . who could consider and use the science of their day." This volume will introduce to British readers the personality of a great ornithologist and a great artist. It contains twelve coloured plates from original Audubon prints; those of the blue-winged teal and sandhill crane are specially attractive.

E. W. HENDY.

Spider Wonders of Australia. By KEITH C. McKEOWN. (Angus & Robertson. 6s.)

One result of Mr. McKeown's book will be a considerable decrease in mortality among spiders in the Antipodes, for after reading it even the most timorous will be too interested in what the spider is doing to wish to kill it. The author explains all the actions of these strange beasts, actions which one has supposed were done simply to annoy, but which he shows to be part of the very remarkable scheme of things by which the spiders live and propagate. Spiders that "fish" for their prey with a sticky globule on the end of a line; spiders that catch their insect food in a gladiatorial net, that impersonate ants, bark, catch fish, snare birds: all these are described in detail.

The chapter dealing with *Nephila*, the bird-snarer, is of particular interest. The aborigines fabricate fishing-nets, smothering caps, and "dooming" bags from the webs of these huge creatures, webs so strong that a single strand will knock off a man's hat. The poisonous "red-back" and the "trap-door" spiders receive a chapter each, and at the end the scorpion and tick are briefly dealt with. English readers of this remarkably well-illustrated book will find all fear of our puny spiders banished when they read that the house-infesting Australian "huntsman" (called in Australia "triantelopes," a corruption of *tarentula*) measures up to six inches across the legs.

Short Notices

Readjustment in Lancashire (By Members of the Economics Research Section of Manchester University; Manchester University Press, 4s. 6d.) brings up to date certain aspects of the Industrial Survey of the Lancashire Area made for the Board of Trade by Manchester University in 1932. The authors deal with the progress of the Lancashire unemployment problem, and the claims of the mining and weaving districts to be brought under the Special Areas Act. After examining the problem, and rejecting the theory that it is capable of solution without State aid, they give a description and criticism of the government's policy and achievements in the Special Areas, together with the results that such a policy might have were it applied to Lancashire.

Continents New and Old (C. C. CARTER and E. C. MARCHANT; Christophers, 6s.) is the third in the "World of Man" series of

instructional books. Europe is not included, but the geological, physical and social characteristics of the other continents are clearly set out, with frequent explanatory diagrams and photographs.

Changes in the Farm (T. HENNEL; Cambridge, cheap Edition, 6s.) preserves the same text as the first edition, though ten new drawings have been added. The historical value of both text and drawings make the book of unique value for all interested in the country and farming, and at the cheap price there is no excuse for not purchasing it.

The Animal's World (DORIS L. MACKINNON; Bell, 7s. 6d.) is supposed to be for children, but there is no talking down to children in it. There is none of the silly baby talk which so many mothers seem to imagine makes understanding clearer. It is simply and carefully written, never lengthy or dull, and any grown up interested in nature will delight in it. D. Mackinnon has been clever in taking for examples common everyday objects.

The Junior Bird Watcher (E. FITCH DAGLISH; Routledge, 6s.) claims to describe clearly "what the young watcher may hope to see," although with a few alterations the text might well serve for bird-lovers of any age. Unfortunately the pictures, all wood-cuts by the author, are of very little value for the bird-watcher, apart from their artistic merit, and the type in which the book is set is unnecessarily heavy.

Bones (P. D. F. MURRAY; Cambridge, 8s. 6d.) is a study of the development and structure of the vertebrate skeleton. It contains over forty diagrams and photographic illustrations. The question of the relation between the structures seen and the morphogenic factors intrinsic in the elements, and the mechanical elements which act from without, is very fully considered.

Elementary Science (H. WEBB and M. A. GRIGG; Cambridge 2s. 9d.) contains an introduction by Prof. H. M. Fox, and sections on the stars, electricity, light and sound, and biology. The last contains chapters on human physiology and hygiene, and the book should be extremely valuable for the lower forms in schools.

A Modern Biology (E. J. HOLMES and R. D. GIBBS; Cambridge, 3s. 6d.) is a good modern textbook, clearly printed and well-illustrated. The chapter on "Co-ordination and Behaviour" will be of especial value, while that on bacteria, disease and health will do good if absorbed.

The March of Science 1931-1935 (various authors; Pitman, 3s. 6d.), is the first quinquennial review issued under the authority of the Council of the British Association. Of the value of its contents there is, of course, no question, though the drab presentation is regrettable. The various summarisations of the different departments of knowledge are a valuable synopsis for those unable to give much time to keeping abreast of developments.

British Chemicals and Their Manufacturers (Association of British Chemical Manufacturers), the official directory of members of the Association in six languages, is issued gratis to genuine buyers of chemicals.

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